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The Illuminating Engineering Society in Holland

EVERY year we see new evidence of the growth of the illuminating engineering movement abroad. The two earliest Illuminating Engineering Societies were those founded in this country and in the United States. In Germany, where the Deutsche Beleuchtungstechnische Gesellschaft was formed shortly before the war, there are now also two local societies at work in the Karlsruhe and Rhine-Westphalian areas, and in Austria-Hungary and Japan societies have been in existence for a number of years.

The latest country to decide to form an illuminating Engineering Society is Holland. Through the courtesy of Dr. N. A. Halbertsma, one of our valued correspondents in Holland, we have received an account of the inaugural meeting (see pp. 230-231). Dr. Halbertsma, who is associated with Philips Lamp Works at Eindhoven, is one of the chief moving spirits in this enterprise, and as he is familiar with developments in illuminating engineering abroad his services should be of great value to the new society in its early stages. It will be noted, however, that the list of those participating in the inaugural meeting was a very representative one. Besides leading gas and electrical bodies, a number of Government Departments and important scientific and technical bodies were represented. The aim has evidently been the same as that underlying the Constitution of the Illuminating Engineering Society in this country—to ensure that all aspects of illumination and professions concerned with lighting are represented, so that the society may be regarded as an impartial body " with no axe to grind."

In his preliminary address Dr. Halbertsma emphasized various aspects of illumination that have been the subject of special consideration in this country, dwelling especially on the importance of good lighting in the interests of safety, health and efficiency. It is interesting to observe that Mr. Gorter, the Engineer and Manager of the Museum of Industrial Safety and Hygiene, is taking an active part. Mr. Van Thienen, Deputy Director-General of the Department of Labour, expressed his recognition of the great value of the society in connection with factory lighting, and alluded to the lighting requirements embodied in Dutch factory legislation thirty years ago. It is a remarkable fact that Holland should have framed definite recommendations on industrial lighting so far back as this, and it is fitting that this progressive country should now be forming an Illuminating Engineering Society.

Visitors to Holland have reported to us the great progress that has been made in lighting in that country during recent years. We have no doubt that the scheme of propaganda outlined will result in still further advances. We shall watch with the greatest interest the progress of the Dutch Illuminating Engineering Society, and especially the part which it is destined to play in the international treatment of illuminating engineering.

The Relation Between Intensity of Illumination and Speed of Work

SOME further studies of the lighting of American post offices, of which Dr. J. E. Ives has sent us particulars (see pp. 227-228), help to confirm the conclusions already formed in regard to the effect of illumination on speed of work. Dr. Ives has endeavoured to express this relation by a general formula, the constants of which can be varied according to the nature of the work, the material and other factors. Generally speaking, the formula expresses the fact that efficiency and speed of work at first increase rapidly as the illumination rises, but afterwards more slowly, until ultimately a point is reached when further increases in illumination have relatively little effect. But the " economic limit " of the illumination, thus defined, will vary according to the kind of work and the constant adopted in the equation.

The shape of the general curve is also affected by the proportion of time during which the eye is in active operation. In all industrial processes there are periods when the eye is quiescent and when the work could almost be done " with the eyes shut "; but there are also periods when the eye is unceasingly vigilant, and it is during this time that the influence of good illumination tells. On the proportions of time during which the eye is respectively active and quiescent the general effect of better illumination in improving production largely depends.

The same problem is studied from a slightly different aspect in the address by Dr. H. Lux, recently delivered in Leipsic (p. 228). He, too, points out the importance of considering the action of the eye. It is here that one finds the chief difference between laboratory tests and experience in the factory. In laboratory tests of the relation between illumination and acuteness of vision the observer can keep his eye steadily directed on the object examined. But in performing most practical tasks the eyes are in constant motion. In order that a clear image may be formed on the retina and perceived, the eye must remain stationary for a sufficient interval—a time estimated at from 0.07 to 0.1 sec. But if this time is less than the " recognition time " (the time necessary for the image to be conveyed and recognized by the brain), the eye may fail to

perceive an object. The time necessary for this recognition depends to a considerable extent on the brightness of the object, i.e., on the illumination provided. If the illumination is insufficient the inevitable result is that all processes of vision are slowed down. It may even happen that if the inspection is not sufficiently deliberate the eye may overlook an object entirely. Here we have a possible solution of many factory accidents, otherwise inexplicable, when an operator has unaccountably failed to observe something normally evident.

All these experiments, by which the theory of the relation between illumination and vision is being built up, and its application to industrial practice developed, seem to us exceedingly important.

There is now available a very considerable amount of information on such subjects, as is illustrated by the admirable compilation recently prepared by Mr. R. J. Lythgoe for the Committee of the Medical Research Council on the Physiology of Vision (see p. 234). It should be our next task to analyse this information, if necessary clearing up apparent discrepancies by further tests, and to deduce general conclusions as a basis for illuminating engineering practice.

Gas and Electricity—Showrooms and Service

IN a thoughtful editorial under the above title *The Electrical Review* recently drew attention to the fact that the Electricity (Supply) Bill is being paralleled by similar developments in the gas industry—such as the legislative proposals intended to free gas undertakings from certain drawbacks. The visits of Their Majesties the King and Queen to the Beckton Gas Works, and the inauguration more recently of extensions in the Gas Light and Coke Co.'s station at Fulham by Sir Phillip Cunliffe-Lister, the President of the Board of Trade, are signs of the times. Sir Phillip, in justly appraising the vastness of the gas industry and its services to the country, expressed the belief that gas and electricity, whilst rivals in certain spheres, had also great opportunities for co-operation "as allies in a progressive service." This belief we share, but it is well, as *The Electrical Review* suggests, that those in each industry should watch what the others are doing and profit by their experience to repair gaps in their own organization—a practice from which the public should benefit.

The particular point emphasized by our contemporary is the large allocation (£750,000) that has been set apart by the Gas Light and Coke Co. for new showrooms. One of the first steps in this direction is to be seen in the new showrooms of the Gas Light and Coke Co. at Horseferry Road, some illustrations of which appear in this number (pp. 240-241). From the illuminating engineering standpoint these illustrations are very interesting in that they depict "model rooms" showing the the actual use of lighting fittings in practice. We have always contended that such demonstrations are more influential, so far as the general public is concerned, than displays of isolated fittings—and still more effective than illustrations in catalogues, from which the appearance in practice is not always easy to grasp.

During the last few years manufacturers and supply undertakings have been awaking to the need for propaganda on lighting. The excellent demonstrations staged by the E.L.M.A. Lighting Service Bureau are one result of this movement. But it has been justly urged that the facilities for demonstrations by many electric supply undertakings still fall far short of what is required. There are some enterprising exceptions—such as the well-equipped and extensive showrooms in Hackney and Croydon—but can it be said that throughout the country electric supply undertakings are doing all that is needful to kindle interest in good illumination and demonstrate how modern requirements can be met?

We would like to see in every large city ample facilities for demonstrating good and bad methods of lighting, supplemented by regular talks on illumination. The keynote of such propaganda should be "service" to the consumer. And whilst it is right that gas and electric undertakings should individually exert themselves to attract attention to what they have to offer, their success will be more rapid if they will encourage and support the initiation of a wide movement in favour of good lighting in general, such as the Illuminating Engineering Society is prepared to undertake.

Experiments With the Integrating Photometer

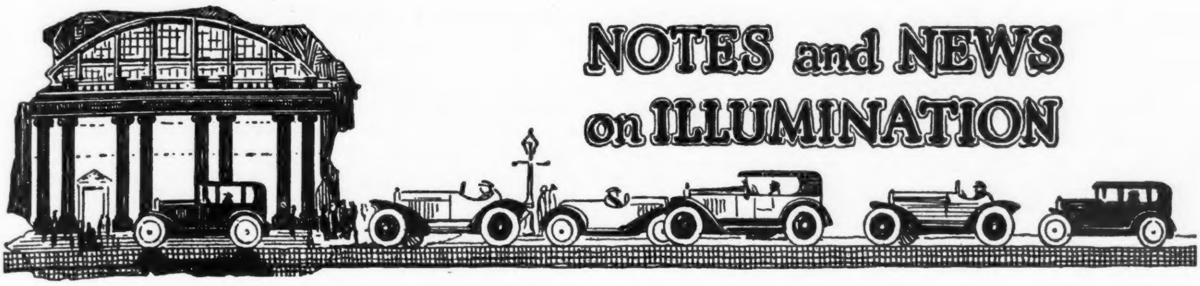
THE general recognition that sources of light cannot properly be compared in terms of light yielded in one direction only has led to a wider recognition of the utility of the "integrating photometer" (or Ulbricht sphere), which enables the total flux of light to be determined by a single measurement. Much experience of its possibilities has been obtained. It may be recalled that some recommendations on its use are being prepared by the Committee on Illumination working under the Department for Scientific and Industrial Research, while one of the B.E.S.A. Committees is also working on the subject, especially in regard to the cubical form.

A spherical integrating photometer is a somewhat costly and elaborate apparatus to construct. A very fine example has recently been added to the equipment of the N.P.L., but there are few available in other laboratories in this country. Interest centres rather in the cubical form, which is so much easier to construct, and some guidance as to the degree of accuracy possible with this form of integrating photometer would be welcome. According to the experience of G. Gehloff in Germany, a box with the corners cut off, having 14 sides, proved to be little inferior to the sphere for most ordinary purposes. Even this, however, is a relatively elaborate apparatus, and it would be useful to know how it compares for accuracy with the simple cube.

At the Optical Convention attention was drawn to one not inconsiderable error, that introduced by the selective effect of the white interior coating. The existence of this source of error has been confirmed by experience in Germany, though its counteraction by the use of appropriate tinted glass is a fairly simple expedient.

Of more serious consequence, especially in integrators of the cubical form, is the effect of want of symmetry in the distribution of light from the lamp tested. Appreciable discrepancies have been found in testing lamps with filaments of widely different shapes. But little data has been published showing how far it is posible to rely on measurements of candle-power made with lamps in highly concentrating opaque reflectors and giving very unsymmetrical light distribution. Can even an integrator of spherical form be regarded as correctly indicating the mean spherical candle-power of such a source as this?

Yet another point which one would like to see studied is the possibility of applying integrating photometers to gas lamps and other flame sources. Dr. H. Lux has recently described a device which apparently enables measurements of gas lamps to be made, and one would like to see confirmatory tests in this country.



Institution of Public Lighting Engineers

As previously announced, the third Annual Meeting and Conference of the Institution of Public Lighting Engineers is to be held in Newcastle during September 14th-16th. Delegates will be received by the Lord Mayor of Newcastle and entertained to luncheon by the Chairman (Alderman Alex. Wilkie) and others. In addition to the address by the incoming President (Mr. R. Davison, Superintendent of the City of Newcastle Lighting Department), several papers will be read dealing with various aspects of public lighting. Amongst these will be a communication by Mr. H. Dickinson (City Electrical Engineer and Lighting Engineer of Liverpool), entitled "Some Aspects of Electric Street Lighting in Liverpool." It will be recalled that Mr. Alex. C. Cramb, Hon. Secretary of the I.M.E.A., is expected to become the President in 1927, when the annual conference will be held in Brighton.

The British Association Meeting

The British Association is this year meeting in Oxford, the opening day being August 4th, when H.R.H. the Prince of Wales will assume the Presidency, and will deliver an address which is expected to deal, *inter alia*, with relations between scientific research, the community and the State. As usual, the papers cover a wide range of topics. We notice that Sir John Snell is dealing with "Electricity Supply: Its Present and Probable Future Development." There are also other papers reviewing progress in spectroscopy and theories of light, and there are several topics, such as the account of recent discoveries in the Gobi desert, likely to kindle the popular imagination. The discussion under Section L on "The Educational Value of the Cinema and Wireless Broadcasting" should also prove interesting.

Street Lighting in Bradford

Our attention has been drawn to the discussion reproduced in *The Yorkshire Argus* of the proposals made by Mr. Colquhoun, the Public Lighting Engineer of Sheffield, for the improvement of street lighting in Bradford. In a report following his inspection of the lighting conditions in Bradford, Mr. Colquhoun recommended the appointment of a street-lighting engineer. His proposals in regard to gas lighting seem to have been the subject of some criticism, Mr. Wood (the Gas Engineer) contesting Mr. Colquhoon's recommendation of the substitution of inverted burners for upright ones, the introduction of more efficient forms of lanterns, and automatic control of street lamps, and other alterations. One is somewhat surprised to find a disposition to adhere to the upright type of mantle, as in other cities the superheated inverted mantle has been found to be much more efficient and more economical in maintenance. Experience in Newcastle on this point, for example, seems to have confirmed the desirability of the change. The advantages of the more modern inverted burners have been frequently emphasized in papers—for instance, in that read by Mr. Sandeman before the Illuminating Engineering Society a few years ago. The difference of opinion expressed on this and other matters, to our mind, only serves to emphasize the need for a qualified public lighting engineer being appointed in Bradford, as we hope will ultimately be the case in all large cities.

Luminous Traffic Signals in Piccadilly

For some time luminous signals have played an important rôle in facilitating the control of traffic in some American cities, and it was generally understood that, following Sir Henry Maybury's visit to the United States, similar devices might be introduced in this country. Needless to say, the conditions in London and other cities in this country are widely different from those existing abroad, and it should not be assumed that identical methods will answer in all cases. Nevertheless luminous signalling should often prove useful, and some experiments with coloured signals are now being made in Piccadilly, in conjunction with the special rotatory traffic scheme recently introduced. At the time of writing experiments with the coloured signals are about to begin. These tests will be watched with general interest. Meantime there is one point that requires to be made clear. The luminous signals are intended as an indication to police officers controlling traffic at various points, and will no doubt help considerably in expediting concerted effort. The signals are not intended as an indication to motorists, who will still be guided by the officer on duty. This seems the most natural method of introducing luminous signals. Their use should simplify the work of the police, but at very busy centres it hardly seems likely that control could be effected by automatic signalling alone.

Sanitary Advances at Sea

A paper on the above subject, by Fleet-Surgeon W. E. Home, R.N., O.B.E., appears in the July issue of the Journal of the Royal Sanitary Institute. There is perhaps no field of sanitary science in which such great progress has been made during the past 50 years. Looking back to 1876, it seems now incredible that such conditions could have been tolerated, and that such grave defects only remedied so slowly. The confined, ill-ventilated and ill-lighted quarters of seamen were the causes of many breakdowns and much sickness. An instructive comparison of statistics on sickness and accidents in the Royal Navy in 1876 and 1922 shows that disease has been reduced 50 per cent, and deaths from disease to only a third. Similar improvement is shown in the figures for accidents. Port Sanitary Authorities were not established until 1872, and the study of maritime hygiene was not taken up seriously until 1894, when a conference on the subject was held. One of the most potent improvements has been the covering of bare iron with cork cement. The naked iron constantly chilled the space occupied by the crew and led to continuous deposit of moisture. Recommendations of Dr. W. Collingridge, Medical Officer of Health for London, contained many useful recommendations, amongst them being the demand for good lighting and the use of white paint. The latter point was again emphasized quite recently in the Board of Trade's Instructions to Surveyors. Electric lighting is recommended, and it is specified that crew spaces shall be washed quarterly and painted white or light colour every two years. Even to-day there is little doubt that on many vessels improvements in lighting—a specially important consideration below decks, where there is little or no opportunity for access of daylight—are urgently needed. In the Royal Navy this is now fully recognized, as was illustrated in the very practical manual recently issued by the Admiralty on Ship Lighting, and commented upon in this journal last year.*

* *The Illuminating Engineer,* Vol. XVIII, 1925, p. 146.

Women's Engineering Society

FOURTH ANNUAL CONFERENCE.

The fourth Annual Congress of the Women Engineers will be held at Leeds University on September 3rd-6th. Visitors will be received by the Vice-Chancellor, Dr. J. B. Baillie, and the Lord Mayor will give a civic welcome. The Presidential Address is to be delivered by Mrs. L. A. Willson, M.B.E., and papers on Stainless Steel and Portable Electric Tools will be read by Miss C. Griff and Mrs. M. L. Matthews respectively. Various social events and visits to local factories have also been arranged. Further particulars may be obtained from the General Secretary, Miss C. Haslett, 26, George Street, Hanover Square, London, W.1.

Atmospheric Pollution

In his recent annual report on the public health of the city of Birmingham, Sir John Robertson, C.M.G., the Medical Officer, deals in some detail with the smoke nuisance—naturally a matter of consequence in an industrial city such as Birmingham. A smoky atmosphere is now recognized to be a menace to health and cleanliness, and its action in obscuring sunlight and shutting off the ultra-violet rays is specially detrimental. Sir John quoted the experiments of Professor Cohen, of Leeds, who found that about 6 per cent. of the carbon consumed in a factory or domestic fire passes up the chimney in the form of soot. There is also a definite amount of tar, which gives the soot a particularly adhesive character—not to mention sulphurous acid and other undesirable impurities injected into the atmosphere. The remedy lies in the adoption of more efficient methods of burning fuel, and Sir John refers to the active work performed in this direction by the Birmingham Gas and Electricity Supply Departments. Impressive figures are quoted to show the way in which open coal hearths and coal-fired steam boilers have been replaced by gas stoves and gas engines. According to the Report of the Coal Commissioners, about 150 million tons of coal are still being burned in a raw state every year. There is therefore ample room for improvement.

Flicker from Lamps on A.C. Circuits

We notice that, according to *Electricity*, a Glasgow consumer has been complaining of the incessant "twinkling" of electric incandescent lamps, contending that since the introduction of alternating current supply it has apparently become impossible to obtain a steady light. Without knowing the circumstances, one cannot, of course, diagnose the cause of the "twinkling" in this particular case, but we may doubt whether it is associated with the use of alternating currents. The question of possible flicker from incandescent lamps run on alternating-current supply is now being studied by the Illumination Research Committee working under the Department for Scientific and Industrial Research. The Committee will doubtless give us a definite ruling on this point in due course. Meantime such data as are available suggest that any tremor in the light of ordinary incandescent lamps due to the frequency of an alternating-current supply can only arise in the case of lamps of low wattage and on exceptionally low frequencies sometimes used for traction circuits, such as 25, or possibly 40, cycles per second. Even so, the fine tremor is not a very evident phenomenon, and could hardly be described as "twinkling." Transitory fluctuations in light may occur on a lighting circuit, whether alternating current or direct current, when the load is coming on at peak-time. But one usually finds that the source of habitual flickering is something wrong in the consumer's own circuits. We have met cases, for example, when a badly fitted fuse or a switch with worn contacts proved sufficient to produce this irritating defect. Gas companies likewise endure occasional complaints of "bad gas" which prove to be due to purely local defects on consumers' premises—such as partially stopped pipes or deranged burners. In such matters the average consumer still requires education. He can rarely distinguish between faults in the supply system and defects in his own apparatus.

Fine for Failure to Supply Electricity

AN ECHO OF THE STRIKE.

It will be recalled that for a short time during the General Strike the supply of electricity was cut off from a number of factories in certain areas in London. A sequel on July 22nd was the action brought by Messrs. D. Gilson & Co., screw manufacturers, and four other firms, against the Walthamstow Urban District Council. It was stated that on May 6th the electricity supply was cut off, although the Council, under a penalty of 40s. a day, were bound to supply electricity unless failure was due to an accident. Mr. Spurr, the Electrical Engineer, explained that the Council received an ultimatum from their employees that all men would be withdrawn if the Council supplied power for industrial purposes after 3 p.m. On his return from a Joint Industrial Council meeting he found that orders had been given to his assistant that power was to be cut off.

A fine of £7 7s., with 25 guineas costs, was imposed on the Council. This is obviously a decision of considerable importance to manufacturers using electricity.

The Institution of Fuel Economy Engineers

A circular addressed to members of the Institution of Fuel Economy Engineers draws attention to the independent effort to establish another body with apparently similar aims—the Institution of Fuel Technology. Efforts have been made to unite the two bodies, but so far these have been abortive, the chief difference of opinion being concerned with qualifications for membership. It seems unfortunate, in view of the continually increasing number of technical societies, that the activities of those concerned with fuel economy cannot be concentrated under the auspices of a single body. We hope that the negotiations for union will be renewed and that ultimately a working basis for amalgamation will be found. Meantime we are informed that the Institution of Fuel Economy Engineers has arranged an attractive series of lectures, informal luncheons and meetings for the period up to the end of January, 1927; particulars of these events will be issued shortly.

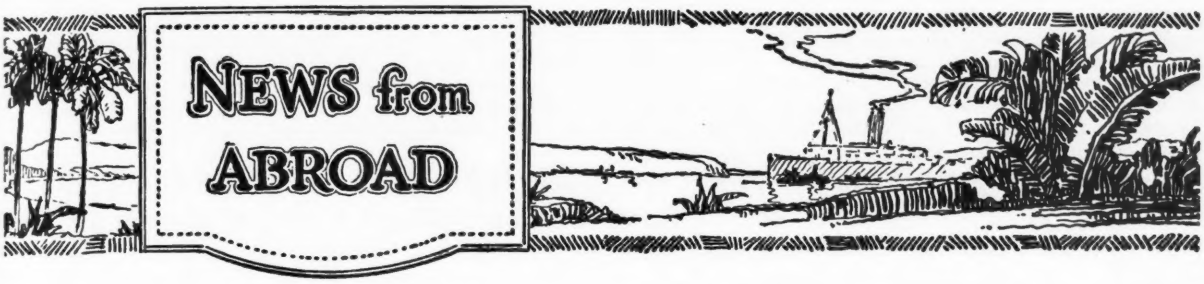
The Gas Light and Coke Co.'s Bill

A Bill, already passed by the House of Commons, contains some important provisions affecting the finance of the Gas Light and Coke Co., in particular a modification of the sliding-scale scheme enabling the dividend on the ordinary stock to be maintained at a minimum of 5 per cent. This last clause has been keenly discussed in committee. The arrangement by which the permissible dividend depends on the charge for gas is a very unusual one, and whilst originally framed as a protection to the consumer, it may be recognized that some modification is justified now. In these days 5 per cent. is a very moderate yield on securities, and inability to maintain this, even though profits may amply justify it, is naturally a drawback in raising new capital, besides being a hardship to the the 15,000 co-partner employees who are co-partners in the company.

Obituary

JAMES STEWART.

We record with regret the death of Mr. James Stewart, for many years Editor of *The Gas World*, on July 28th. Mr. Stewart was an able journalist with wide interests, and had a considerable amount of general experience before becoming the chief proprietor and Editor of *The Gas World*. When the journal was taken over by Messrs. Benn Bros. Ltd. he became a director, and continued to act as editor until his retirement in 1918. He was widely known both in the gas industry and in the journalistic world, and the news of his death will be learned with regret by many friends.



The Japanese Illuminating Engineering Society

Recent *Transactions* of the Japanese Illuminating Engineering Society contain much varied matter. Mr. Y. Ogawa describes the street lighting of some American cities, and Mr. K. Imai deals with lighting at the Paris Exhibition. There is also a contribution by Mr. Z. Yamouti on "Isocandle" diagrams. These diagrams, it may be recalled, utilize contour curves not unlike those usually adopted in plotting distribution of illumination; but in this case, as the name suggests, it is lines of *equal candle-power* from a source that are plotted. The author's method appears to differ somewhat from that originally proposed by Mr. Benford in the United States. The *Transactions* also contain numerous abstracts of papers on photometry and illumination, and lists of references, amongst which some recent articles in *The Illuminating Engineer* are included. For example, the "British Standard Specification for Portable Photometers," and Dr. Halbertsma's article on a new enclosed tungsten arc lamp are abstracted. One is struck by the attention devoted to the more scientific aspects of the subject, such matters as the theory of diffusion, diffused reflection, selenium and photo-electric cells, etc., receiving considerable attention. The method now adopted of giving titles of papers in English as well as Japanese is a decided help.

Illuminating Engineering in Karlsruhe

The fifth Annual Meeting of the Lichttechnische Gesellschaft took place in Karlsruhe on June 25th and 26th. Following the usual report for the year by the Chairman, a series of papers, mainly reviewing progress in various illuminants, were read. Amongst these may be noted: The Story of Development in Gas Lighting from the Open Flame to the Incandescent Burner (Prof. Dr. Eitner); The Industrial and Practical Position of Gas Lighting in the Past Century (Prof. Dr. Bunte); The Development of the Electric Incandescent Lamp (Dr. A. R. Meyer); Practical Problems in Electric Lighting (Dr. N. A. Halbertsma); and Recent Developments in Arc Lamps (Herr Laue). We hope shortly to give some account of these various papers.

The Illuminating Engineering Society (U.S.A.)

TWENTIETH ANNIVERSARY CONVENTION.

Marking the founding of the Society in 1906, the Twentieth Anniversary Convention of the Illuminating Engineering Society is to be held at Spring Lake, New Jersey, from September 7th to 10th inclusive, with headquarters at the Essex and Sussex Hotel. The Convention will commemorate the completion of twenty years of progress in furthering the objects of the Society; and the great advances and developments which have been made during this period, in which the Society has taken such a prominent part, will be fittingly observed.

Spring Lake is a popular summer resort located on the Atlantic Coast, a short trip from New York and Philadelphia. The Essex and Sussex has been chosen as being particularly well adapted to meet the requirements of an I. E. S. Convention. The hotel is ideally located directly on the ocean front, is beautifully appointed and admirably equipped to contribute to the enjoyment of those attending.

A programme of diversified and comprehensive papers has been arranged by the Committee on Papers including subjects of great practical interest. A special feature of the programme, particularly appropriate at this time, will be a session devoted to developments in the art of illumination which have taken place during the twenty years of existence of the Society. Another session, which will be of interest to central-station lighting men, will be devoted to the presentation and discussion of the Lighting Sales Manual, prepared by a joint committee of the Illuminating Engineering Society and the National Electric Light Association. The Manual outlines methods found most efficient in promoting good lighting by central stations by some of the leading illuminating engineers of the country. Central-station lighting men from the leading public utilities are to be invited to discuss the manual and promote its adoption and use.

At another session, under the auspices of the Committee on Natural Lighting, there will be presented a series of interesting and practical papers covering a variety of subjects such as the effect on illumination of dirt accumulation on glass, distribution characteristics of various types of glass, natural lighting in schools, and the relative effectiveness of various methods of light control through windows. Other papers depicting the great part that lighting can perform in the world's work and in its relation to human happiness will be discussed.

The Convention will bring to a close the first twenty years of the Society's existence, but it will likewise mark the beginning of a new era in which lighting is destined to become increasingly important in the world's activities.

Two Novel Lamp-Hangers for Industrial Lighting

Apart from the design of lighting fittings from the standpoint of direction of light, the *method of suspension* is in many factories equally important. The success of an installation may depend mainly on ease of maintenance. *The Electrical World* illustrates two lamp-hangers specially designed for this purpose. The first of these was intended for use in a lumber mill. The floors of such mills are usually so encumbered that step-ladders are inconvenient and sometimes precarious. The problem was solved by placing stout wooden planks across the iron girders, and mounting overhead units on these. The maintenance man can get access to the system of planks from the side of the room. Seated on a plank he can attend to any unit immediately below him. In order to enable the unit as a whole to be swung upwards it is mounted on a species of swivelling bracket, and the leads are encased in a good length of flexible tubing. The worker has thus only to lean down and release a clamp, and he can swing the whole unit upwards into his lap. The second unit described is simple in character and of more familiar design. The unit swings on a hook, from which it is easily detached, and the flexible leads are connected to a plug-connector, which is released when the unit is to be removed. The operator can thus quickly detach the unit as a whole and substitute an entirely new one from stock whilst the one replaced is being cleaned or otherwise brought into good condition. The system is sometimes adopted in factories in this country. It has one additional

advantage—namely, that after the wiring to the plugs is completed the units can easily be shifted a short distance by merely altering the position of the hook and without touching the wiring. This is often a convenience in factories where the floor is occupied by machinery, and a slight adjustment of the position of the unit is rendered desirable, either in order to eliminate a troublesome shadow or to adapt the lighting to some alteration in the positions of machines.

A Special Camera for Photographing Cylindrical Objects

A camera designed to deal with a somewhat special problem, the photographing of the entire superficial surface of cylindrical objects, has been recently described in a Bulletin issued by the Bureau of Standards, Washington. This form of camera is specially useful for recording changes in the surface of cylindrical pipes, e.g., effects of corrosion. The procedure is as follows:— The cylinder to be photographed is mounted with its axis parallel to that of the roll of film in the camera, to which it is connected by a belt-drive, and both are driven by the same electric motor. The drive is so arranged that the image thrown on the film moves at the same speed and in the same direction as the film itself. The image reaches the film through a narrow slit, which is opened automatically when the motor is started and is similarly closed, and the motor stopped, when the cylinder has made one complete revolution.

The Study of Luminous Radioactive Materials

A useful survey of knowledge of radioactive luminous materials, and of methods of measuring their brightness, was recently contributed by K. W. F. Kohlrausch, to *Lichttechnik*, and is also summarized in *The Revue Générale de l'Electricité*. Much attention was attracted to this subject by the wide applications of these luminous paints during the war. It may be recalled that a series of tests of materials used for gunsights was made by a committee of the Illuminating Engineering Society in this country. The data now presented are in general accord with the information obtained by this committee. The complexities of the subject are illustrated by the fact that we have not only to consider the slow progressive change in the intensity of emissions from radium, mesothorium, and other excitants, but also changes in the excitability of the luminous material (usually zinc sulphide with minute additions of certain substances such as copper, manganese, etc.). The author reproduces the familiar curves showing the decay in luminescence with time. A certain case is made out for the use of mesothorium in reference to radium bromide, or at least in mixture with it, in cases when the useful life of the compound is expected to be relatively short. The photometry of such materials and the special methods necessitated by their very weak luminosity are considered in detail. Various more or less elaborate arrangements of lenses and prisms have been incorporated in special photometers with a view to rendering the tests as sensitive as possible. It is somewhat surprising, in view of the very low brightness, to find that photo-electric cells have apparently been used for this work. The fact that all personal errors and difficulties arising from the operation of the eye at this weak luminosity are thus avoided is a very great advantage. On the other hand, an exceedingly sensitive apparatus has to be used, and its manipulation requires considerable experimental skill.

The Use of Artificial Light in Horticulture

Another series of experiments on the effect of artificial light on the growth of plants has recently been made by the Westinghouse Lamp Co. (U.S.A.) in the greenhouses of Messrs. Peter Henderson & Son, seedsmen, in Jersey City. These experiments seem to have fully confirmed others in suggesting that exposure to artificial light has an important influence in hastening development of plants. In this case exceptionally full information was obtained by the use of films recording the stages of growth, which could subsequently be run at slow speed. In this way the actual growth at different stages could be strikingly surveyed, the plants which were respectively grown under ordinary conditions and stimulated by artificial light being seen to "grow up" side by side before the eyes of the audience.

The Influence of Very High Illuminations on Difficult Forms of Fine Work

Last year we summarized researches, undertaken under the supervision of Dr. W. Ruf r in the Osram G.m.b.H. Laboratory, in Berlin, designed to test the relation between illumination and various processes exercising special faculties. It will be recalled that somewhat variable results were obtained, though in general the tests supported the conclusion that higher efficiency of work results from greater illuminations. An account of a further series of experiments by the same investigator has now been described in *Licht und Lampe*. In these cases special measures were taken to render the processes more difficult and requiring a high degree of visual acuity. Thus very fine pins were viewed against a relatively dark background instead of a light one. Charts are presented showing the results obtained for different processes. It is again found, as might be expected, that the effect of higher illumination is much more marked in some cases than in others. A progressive increase in efficiency appears to have been recorded with higher illuminations for all the processes designed primarily to test acuity of vision. In these tests the illumination was carried to much higher values than before, viz., up to 10,000 lux (approximately 1,000 foot-candles). Inspection of the diagrams relating to visual acuity suggests that up to 300 foot-candles there was a progressive rise in efficiency. From 300-1,000 foot-candles the effect was less evident. In several cases results appear to be practically stationary over a range of 100 to 1,000 foot-candles. The interpretation of such laboratory experiments in relation to industrial practice obviously requires discretion. But they afford a convenient means of separating the different faculties, and form a useful supplement to practical tests.

Obituary

PAUL ADOLPH LEOPOLD HEYCK.
Born October 12th, 1874. Died July 8th, 1926.

We record with regret the death of Dr. Paul Heyck on July 8th, at the early age of 51 years. Dr. Heyck was associated with Messrs. Körting & Mathiesen (Lautsch. b. Leipsic), and his name was well known in this country as the author of many papers on illumination. Little more than a year ago he expressed his great interest in the publication of *The Illuminating Engineer* in its revised and extended form, and consented to become one of its correspondents in Germany. Dr. Heyck was born in Doberan on October 12th, 1874. After studying for a short time at Heidelberg University and at the Technische Hochschule at Hanover, he entered the works of Lahmeyer & Co., but transferred himself to Messrs. Körting & Mathiesen in 1907. Thenceforward his work was concerned largely with lighting problems, and he brought to this work an exceptionally wide and studious outlook. We have referred recently to several handbooks issued by him in which the main principles of illuminating engineering are clearly expressed and illustrated. But he did a great deal of work towards the promotion of interest in illumination in Germany and the preparation of recommendations on lighting which is not directly associated with his name. He combined to an exceptional extent scientific knowledge and engineering skill. But he had many other interests, music, art, literature and nature, which are apt to be neglected by engineers. His bright and kindly nature gained him many friends, and illuminating engineering all the world over is the poorer by his early death.

TECHNICAL SECTION
COMPRISING
Transactions of The Illuminating Engineering Society and Special Articles
The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Further Studies in Regard to the Lighting of Post Offices

ATTENTION was drawn last year to the researches conducted by the United States Public Health Service into the lighting of post offices, described in several papers by Dr. J. E. Ives.* It will be recalled that the investigation comprised tests of speed and accuracy of sorting letters, which were related to the conditions of illumination provided, and also examinations of the eyesight of operators. As a result of these tests the benefit of better illumination in improving speed and accuracy of work was clearly shown, the greatest speed of sorting being reached with an illumination of about 8 foot-candles, for operators with fairly good vision; operators falling within the group having poorest vision, however, only attained maximum speed with an illumination of 14 foot-candles. It was determined that in future the initial illumination on the working plane should not be less than 10 foot-candles, which allows some margin for deterioration during use. Considerations of requirements in post offices also led to the recommendation that the brightness of lighting units installed should not exceed 2·5 candles per square inch.

These researches are again dealt with in a paper presented by Dr. Ives more recently,† and this paper contains some data which is supplementary to that previously presented and reproduced in this journal. One of the most interesting items in the new matter is the record of eyesight conditions of workers at different ages. Dr. Ives, in the original paper, presents data on the vision of 4,862 native white schoolboys and 6,479 male white industrial workers in the United States. This record is interesting in suggesting that apparently the greatest acuity of vision is reached at about 18 years of age.

The records obtained for mail sorting tests led Dr. Ives to suggest that in most industrial operations the relation between illumination and speed of work could be represented by a formula of the general character—

$$P = P_c\,(1 - e^{-kI}).$$

Here P is the actual production with an illumination I. P_c and k are constants. P_c is the value of the production rate under good daylight illumination; k is a constant which depends on the nature of the work and the physical and mental characteristics of the worker. If P_c is taken equal to 1 the formula becomes—

$$P = 1 - e^{-kI}.$$

The shape of the curve connecting illumination and production is determined largely by the value assigned to k. Thus with $k = 0{\cdot}1$ the curve, for illuminations up to 10 foot-candles, approaches a straight line, showing that the improvement in production with rising illumination is uniform and continuous. With higher values of k, however, the curve bends, and with $k = 4$ the maximum production would be reached soon after 1 foot-candle.

It will be seen, therefore, that by suitably choosing the value of k the curve can be made to suit most industrial operations. For a very simple operation k would be relatively high, whilst for exacting and intricate operations which call for a high degree of illumination before the "saturation point" is reached it would be relatively low. With $k = 1$ the maximum production, for all practical purposes, is reached at 8 foot-candles, so that this value would appear to fit many cases of moderately fine work. The shape of the curve and the value assigned to k (which may be regarded as a measure of the ocular case of the task) are really largely determined by the proportion of the working time during which the eye is actively occupied. In the case of letter separating and similar tasks the actual time may be divided into two portions; one, during which the eye is at work, which is affected by the illumination; and another portion, during which the eye is quiescent, which is unaffected by the intensity of illumination.

In order to study this matter further some new tests of card-sorting were made at Washington. These were designed to ascertain what happens when the illumination is very low. The ocular task was simple. Each of forty white cards had a number consisting of ten digits typewritten in black on an Underwood typewriter especially designed for statistical work. Each digit was 2 mm. high and 1·6 mm. broad, and together they occupied a total space of 24·5 mm. Ten of the cards had 1 zero in the number; ten, 2 zeros; ten, 3 zeros; and the other ten, 4 zeros. On none of the forty cards, however, were the zero digits arranged in the same order. The task was to sort out the forty cards into four piles so that all the cards in a pile should have the same number of zeros. After the cards had been sorted according to the number of zeros, and the number of errors made in the sorting determined, the cards were twice distributed into four piles without looking at the numbers on them. The objects of the latter procedure were (1) automatically to mix the cards so that no two cards having the same number of zeros would be consecutive in the next sorting; (2) to determine what portion of the time had been taken up by the purely mechanical part of the process; and (3) to give some information as to the effect of learning, habit and fatigue on the results of the test.

The separation of the cards into four piles without looking at the numbers is referred to as "distribution" to distinguish the process from "sorting" the cards according to the number of zeros. The illumination was varied through a wide range from only a few thousandths of a foot-candle up to 30 foot-candles. The results are given in the accompanying table, where the initials are those of the persons tested. Inspection shows that in all cases the speed of sorting suffered no appreciable change as the illumination was decreased from 30 foot-candles until an illumination of about 3 foot-candles was reached, when indications of decreased production began to appear for A.F.B. and D.K.B.; S.D.C. did not show

* *The Illuminating Engineer*, Vol. xviii, pp. 98, 211.

† Paper read at the joint session of the sections of Industrial Hygiene and Sanitary Engineering at the 54th Annual Meeting of the American Public Health Association.

marked decrease of production until 2 foot-candles was reached, and R.H.B. not until 1 foot-candle was reached. The reaching of steady values of production at the relatively low illumination of 3, 2, and 1 foot-candles is explained by the fact that the ocular task was an easy one. In the letter-sorting tests, as undertaken in the post offices, the task was more difficult, and the production did not reach a steady value until illuminations of 6 and 8 foot-candles were attained.

TABLE I.

MEAN SPEED OF SORTING UNDER DIFFERENT ILLUMINATIONS TOGETHER WITH THE SPEEDS REDUCED TO AN INDEX BASE OF 100.

A.F.B.			R.H.B.			S.D.C.			D.K.B.		
Mean Illumination in Foot-Candles	Mean Speed of Sorting	Index of Mean Speed of Sorting	Mean Illumination in Foot-Candles	Mean Speed of Sorting	Index of Mean Speed of Sorting	Mean Illumination in Foot-Candles	Mean Speed of Sorting	Index of Mean Speed of Sorting	Mean Illumination in Foot-Candles	Mean Speed of Sorting	Index of Mean Speed of Sorting
—	—	—	29·8	56·6	100	29·8	34·3	101	27·1	31·7	102
7·6	37·4	100	7·9	56·6	100	8·0	33·3	98	7·5	30·2	97
4·0	37·7	100	4·6	56·6	100	4·4	33·8	100	4·3	31·4	101
2·7	36·9	98	3·1	56·6	100	3·0	31·9	94	2·8	27·6	89
1·6	32·9	88	1·7	58·4	103	1·8	33·3	98	1·7	28·5	92
0·92	32·1	85	1·1	55·8	99	1·0	31·7	94	1·0	28·2	91
0·73	30·8	82	0·67	55·2	98	0·76	29·1	86	0·61	25·0	80
0·26	30·7	82	0·27	50·8	90	0·22	25·6	76	0·18	22·4	72
0·096	27·0	72	0·094	46·5	82	0·061	14·8	44	0·056	20·5	66
0·062	25·2	67	0·063	46·9	83	0·033	9·0	27	0·023	18·7	60
0·019	22·2	59	0·017	35·9	63	—	—	—	0·012	14·5	46
—	—	—	0·004	18·5	33	—	—	—	0·008	11·9	38

It is shown that curves of production derived from these tests can be made to fit closely with the standard formula by adding a small constant, a, to the value I. The formula then becomes $P = 1 - e^{-k\,(I+a)}$.

Although much has been learned from these tests there are several points that deserve further study. One of these is the phenomenon of "lag in production," i.e., when the illumination is decreased or increased the production rate does not rise or fall immediately to the value corresponding to that illumination, but only after the new illumination has been maintained for some time. It has been suggested that this "lag" may be due to the development of a habit of faster work, which was not immediately shaken off when the illumination was reduced to its former value. A similar effect has been noted in England by Messrs. Farmer, Adams, and Stephenson in their investigation of the effect of using portable lamps of higher candle-power in coal mines.

The question also arises whether, when the production has been increased by additional illumination, this increase will be maintained or will gradually become less.

This is a specially interesting point in view of the suggestion made in some quarters that whilst "super-illuminations" render possible increases in output, this greater activity may occasion some measure of extra fatigue.

Finally the determination of the fatigue of the eye under different degrees of illumination is desirable, in order to ascertain for what degree of illumination ocular fatigue is least. Studies in connection with these problems are now being carried out by the United States Public Health Service in the main post office in Chicago, and it is expected that valuable results will be obtained from them.

Processes conducted in post offices appear to be a kind specially suitable for tests of this nature, and one would like to have confirmatory data from tests made in this country.

Good Illumination—Good Work*

By Dr. H. LUX

THE title of this address would seem to be self-evident, for inasmuch as the eye acts as the essential aid to carrying on work, so the efficiency of work depends intimately upon light. One cannot see without light—vision is a physiological function of light—therefore one cannot work without light, leaving out of account processes which are purely mental or depend exclusively on the sense of taste or smell.

Yet although all work involves the operations of the eye to a greater or less degree, in most operations there are periods when the eyes might as well be closed as open, whilst the process goes on. In practically all our activities the eye is only in actual use for a certain portion of the time. Hence it is evident that for different forms of work the relations between illumination and efficiency must vary. We must recognize (1) that in the main the eye is only at work for a portion of the time, and (2) that the demands on the eye during this working period may be either exacting or relatively small. Whether an improvement in production will result from better lighting, and how great this improvement will be, depends on a variety of factors. The non-working period of the eye is affected only by ordinary aspects of industrial organization. It is the working period that interests the illuminating engineer, for here it is possible, by better lighting, to improve production.

The subject has been studied both from the theoretical and the practical side. From the theoretical standpoint an important part is played by the reaction time of the eye—the interval of time necessary for a stimulus to produce a sensation. Usually indistinct stimuli act slowly on the retina and the reaction time is relatively great. Yet this may be compensated by a special effort of concentration on the part of the observer. Such personal factors form the greatest difficulties in investigations of this kind. In the case of workers it is necessary to guard against mistrust on their part, which may invalidate results. Results may likewise be falsified if the experiments relate to work that has become thoroughly familiar to the operators; here the force of habit may go far towards compensating for bad illumination.

Experiments have also been conducted having for their basis the least time necessary to recognize some detail. By making many measurements variable factors can hardly be eliminated, so that such observations may serve as an indication of conditions of illumination. But here again there is a difference between observations made in the laboratory and those found in practice. In the laboratory the time of recognition is limited by the fact that the observer fixes his eyes steadily on the test-object and awaits a certain phenomenon. But in practice conditions are different. The eyes of people are for a great part of the time in active motion, and whilst the eye is in motion one does not see. The eyes must be at rest before an image can be formed and perceived. How long therefore must the eye be retained still in order that perception may be possible? This is the "action-time" that is actually used in practice. The shortest time necessary has been variously estimated at from 0·07 to 0·10 second. If this action-time is less than the time necessary for the luminous image to be registered in the brain, a person would naturally not see. In order that an object of considerable size may be seen during the short action-time specified above the brightness of the object observed must be at least 2·57 millilamberts. Assuming the application of Lambert's Law and a surface that is perfectly white this would mean an illumination of 28·5-30 lux (approximately 3 foot-candles). For objects that are not perfectly white and have a reflection factor of less than unity the necessary illumination would be greater. Thus for the usual reflection factor of about 0·5, 60 lux would be necessary.

In practice it may happen that, owing to poor illumination, a worker can no longer see an object clearly during the specified action-time, and he must then take a second and longer look; or he adapts his eye to a

* Abstract of an Address delivered in Leipsic, March 2, 1926.

longer period of inspection than is customarily necessary, and naturally such a slowing down of vision must have a material effect on efficiency of production.

From the purely physiological side the following hypotheses may therefore be put forward :—

1. In human activities vision is a determining factor only for a part of the working period, which may be a greater or less proportion according to the nature of the process.
2. The significance of vision during this period depends on a variety of factors, such as the size of the objects worked with, the conditions of contrast under which they are seen, and the general level of brightness.
3. Losses and accidents attributable to insufficient or faulty illumination may be due not only to absolute inability to see, but to delay in the perception of the luminous image formed on the retina.
4. The time of fixation necessary for the formation of an effective image on the retina is in most cases limited to the short time during which the eye, when directed towards the object to be perceived, finds itself at rest. This time is of the order of 1/10 second or less.
5. Should the brightness or degree of contrast of the object examined not be sufficient to cause an effective impression during the time of fixation, this will result not merely in diminished ability to see but in absolute failure of vision.
6. The avoidance of such failure to see can be ensured only by the maintenance of a slower rhythm of movement of the eye—naturally at the cost of a certain loss of time.

I have given this summary of the physiological considerations underlying the relation between light and vision in order to show that recommendations of good lighting are based on a scientific foundation. (Even to-day there are many people who, recalling their youth, when all work was done by a simple oil lamp, believe that present demands for higher illuminations are excessive, and are made only in the interests of gas or electric supply undertakings!) Herman Cohn, the famous Breslau oculist, in the 'eighties of last century had already come to the conclusion that for ordinary reading and writing 30 to 50 lux (approximately 3 to 5 foot-candles) were necessary. Since then physiological studies have been renewed and experiments both in the factory and the laboratory have been made. In this connection Dr. Lux quotes familiar figures from the United States showing improvements in output secured by better illumination. He also refers to the laboratory experiments of Ruffer. From these and other experiments one can assert with confidence that an increase in illumination beyond 240 lux (approximately 24 foot-candles) is useless and wasteful. Nevertheless the illuminations hitherto used in factories and workshops are too low, and even the values recommended by the Illuminating Engineering Society in Germany might with advantage be exceeded in the interests of more efficient production.

In actual fact good illumination is in the interests of employer and worker alike. In comparison with the advantages of more efficient production the cost of better lighting is insignificant. In addition the effect of better lighting on bodily and mental health should be considered. Further there is no greater enemy to disorder than abundant light.

By good illumination is understood not merely sufficient intensity of light but proper direction, distribution and colour, and conditions of brightness and contrast favourable to quick vision. The requirements of good illumination are:—(1) The illumination must be sufficient, (2) there should be no disturbing contrasts in brightness, troublesome shadows, or inconvenient inequalities in light over the work, (3) there should be no "glare," (4) the installation must be efficient and properly maintained.

Special attention is drawn to the undesirable effects of great contrasts in brightness or variations in illumination over the area of work. Yet completely diffused, approximately "shadowless" illumination is not desired, for shadows play an important part in many processes, especially in the examination of surfaces of goods (paper, textile materials, etc.).

Glare whether from exposed sources or by direct reflection of light from polished surfaces, must be completely eliminated. It may render an otherwise good installation quite valueless. The reception of bright light not only on the central region of the retina but also on the periphery may cause glare. The physiological effect may vary from a slight disturbance to absolute paralysis of vision. Slight cases of glare often fail to be recognized. The diminution in ease of vision leads to a demand for more powerful lamps and the defect is accentuated. One of the best tests of glare is the formation of after-images. If one allows the eye to observe the lighting units steadily for several minutes and then finds on closing the eyes that a negative of positive after-image of the source is perceptible—this is evidence of glare. If, when the eyes are shaded by the hand, one is conscious that one can see more clearly, this likewise shows that the installation is glaring. After-images are often present even when the worker is not aware of them. They then operate as a luminous haze between the eye and the objects observed, and diminish clearness of vision.

The severity of glare depends on the state of adaptation of the eye. To a dark-adapted eye even the flame of a candle is glaring. In full daylight an incandescent lamp or mantle can be observed without much consciousness of glare. The recommendations of the German Illuminating Engineering Society specify that the brightness of a source falling within the range of vision must not exceed 0·75 candles (Hefner) per square centimetre; lighting units having a brightness of 5 candles (Hefner) per square centimetre are permissible, provided the angle between a line drawn from the eye to the source and the horizontal is not less than 30°, as in these circumstances the eye is effectively shaded by the brow. Units of higher brightness must be screened by reflectors, diffusing glassware, etc., so as to bring the brightness down to the desired level.

In conclusion, importance is attached to the proper maintenance of the installation in an efficient condition. Maintenance involves the renewal of lamps, the cleaning of lamps and lighting appliances, the renewal of surfaces of walls, ceilings, etc. Efficiency also depends on many considerations, the choice of general or local lighting, or of large or small units, the selection of lamps of proper voltage, etc.—all points of considerable practical importance.

Board of Trade Announcement

DATING OF PATENTS COMMITTEE.

A Committee has been appointed by the Board of Trade to consider whether any, and, if so, what change is desirable in the practice of

(*a*) Dating patents, applied for under Section 91 of the Patents Acts, as of the date of application in the foreign state; and

(*b*) Dating patents granted upon ordinary applications as of the date of application in the United Kingdom.

The main question which the Committee has to examine is whether this practice should be continued or whether patents granted upon applications made under Section 91 should bear some later date, such as the date of application in this country, or the date of grant of the patent, while still giving the applicant the priority as regards inventorship which must be given to him under international arrangement.

The Committee will be glad to receive suggestions or representations upon the matters covered by their terms of reference. In considering the questions involved, the Committee desires that due regard should be paid to all the interests involved, i.e., the interests of inventors, manufacturers, consumers, and the public generally. Communications should be addressed to the Secretary to the Committee, Mr. B. G. Crewe, The Patent Office, 25, Southampton Buildings, London, W.C.2.

The Inaugural Meeting of the Dutch Illuminating Engineering Society

Held on the 3rd June, 1926, at 3 p.m., in the Museum of Safety, in Amsterdam

AN interesting event on June 3rd was the Inaugural Meeting of the Dutch Illuminating Engineering Society, which was called at the Museum of Safety on the initiative of the Technical and Economical Association.

When the Chairman of the Technical and Economical Association, who presided, opened the proceedings, the following gentlemen were present: Mr. G. J. Van Thienen (Deputy Director-General of the Department of Labour), as representative of the Minister of Labour, Commerce and Industries; Mr. P. J. Van Voorst Vader (Engineer-in-Chief), representing the Minister for the Maintenance of Dykes and Roads and the Navigability of Canals; Mr. A. B. Van Hamel (Electrical Engineer to to the Public Information Service), on behalf of the Industries representing this Service and the Department of Public Buildings; Mr. P. Van Braam Van Vloten (Engineer, Chief of the Coast-lighting Service, member of the Lighting Committee, Royal Dutch Automile Club and Dutch Cyclists' Club), also as a representative of the Royal Dutch Automobile Club; Professor G. Van Iterson, jun. (Chancellor of the Technical University, Delft), also as representative of the Dutch Society of Commerce and Industries; Professor A. D. Fokker (Professor at the Technical University, Delft); Professor L. S. Ornstein (Professor at the Royal University of Utrecht); Mr. J. Aberson (Engineer to the Dutch Railways); Mr. Baart de la Faille (Engineer to the Municipal Electric Company in Amsterdam), representing the Association of Managers of Electric Works in Holland; Mr. Terneden (Engineer), President of the Association of Gas Manufacturers in Holland; Mr. D. H. Stigter, (Consulting Engineer), representing the Society of Dutch Consulting Engineers; Mr. R. A. Gorter (Engineer, Manager of the Museum of Industrial Safety and Hygiene); Dr. G. Holst, Mr. W. J. Waterman, representing Philips' Incandescent Lamp Works Ltd. (Eindhoven); Mr. L. Zealander and Mr. R. A. Wolterbeek Muller (Engineers), representing L. W. Zélander Ltd. (Amsterdam); Mr. J. W. Wolters, representing the Technical Bureau "Marynen" (The Hague); Mr. Roellofs (Engineer), representing Siemens-Schuckert Ltd. (The Hague); Sieliakus, representing Osram Ltd., (Amsterdam); Mr. Van Der Koog (Engineer, of Körting & Mathiesen, Amsterdam); Mr. Chr. Moes (Chairman of the Technical and Economical Association); Mr. J. K. Mercx (Engineer and Government Adviser on Industries, Deputy Chairman of the Technical and Economical Association); Mr. F. C. Wirtz, Cz. (Engineer and Manager of the Royal Bureau for Fuel Economy, member of the Board of the Technical and Economical Association); Dr. N. A. Halbertsma (Engineer of the Philips' Incandescent Lamp Works Ltd., member of the Board of the Technical and Economical Association); Mr. L. S. P. Scheffer (Consulting Engineer and Architect, Secretary and Treasurer to the Technical and Economical Association).

In addition, Professor P. Zeeman, of Amsterdam; Professor W. Zwaardemaker, of Utrecht; and Dr. H. K. de Haas, (Oculist, Manager of the Batavian Society in Rotterdam), had given evidence of their sympathy with the aims of the assembly, and regretted their inability to attend.

Mr. Chr. Moes, who presided over the meeting, expressed his appreciation at the response to the invitation of the Council. He specially addressed himself to Messrs. Van Thienen and Van Voorst Vader, and requested these gentlemen to convey the esteem of the Society to the Minister of Labour, Commerce and Industries, and his colleague, the Minister for the Maintenance of Dykes and Roads and the Navigability of Canals; both Ministers desired to comply with the request to have their departments represented.

Although some of those present, having attended previous discussions, were already acquainted with the motives which induced the Technical and Economical Society to hold this meeting, yet the Chairman thought it advisable to afford Dr. Halbertsma an opportunity to briefly explain these motives more fully. Many expressions of appreciation had been received, which were of great importance to the success of the Society in carrying out the difficult and extensive task it had undertaken. Dr. Halbertsma, he mentioned, was one of the few people in Holland who had made a special study of illumination. The Council of the Technical and Economical Association, therefore, considered themselves fortunate in having the assistance of Dr. Halbertsma, who was willing to act as a delegate member of the Council of the Society about to be formed, so that he would be able to assist them by word and deed in the management of its affairs. Dr. Halbertsma's association with Philips' Incandescent Lamp Works might be regarded as a drawback, and Dr. Halbertsma himself had been the first to recognize this. Therefore, he intended to withdraw gradually from active participation in this work as soon as more experience had been acquired, and the movement could proceed without assistance. At the same time he was desirous of having one or two persons to aid him in this somewhat onerous task.

Dr. Halbertsma then proceeded to explain how the idea of forming the Society had originated, and to outline its aims and objects. It could not be denied that the main object of the Society, to encourage better lighting in its widest sense, was a most important one. Indeed it might be said with truth that light played a predominant part in every field of human activity. He wished to explain these applications of light somewhat more fully, and proposed to deal with the subject in relation to (*a*) production, (*b*) traffic and (*c*) recreation. From each of these aspects good lighting was essential. Yet in each individual case conditions of lighting might be different, according to the purpose it was intended to serve. In industry we are concerned with the utilitarian aspect; for example, the influence of better lighting in improving production. In dealing with traffic we are chiefly concerned with the value of good lighting in the interests of safety. Next, from the recreative standpoint, lighting is desired that makes a pleasing and æsthetically satisfactory impression, so that in many cases the element of beauty of effect plays an important part. It would be seen, therefore, that there were many different requirements to be satisfied in achieving good illumination.

Good lighting was of interest alike to employers and employees, to inspectors of factories and to railway engineers. There were many different problems to consider—the design of motor-car headlights and the provision of public lighting, the lighting of shop windows and the uses of luminous signs for purposes of advertisement; the lighting of museums, concert halls and theatres; and problems involved in the projection of light and in kinema theatres.

Of late years it had become increasingly recognized that the hygienic aspect of lighting was a most important one, and it had accordingly been closely studied by physiologists and hygienists. Illuminating engineering thus presented many varied problems which had to be considered from different points of view. There was a danger that these individual aspects might be studied exclusively by specialists, and that mutual contact might be lost. Interchange of views between different experts was essential. There were still many problems to be studied, and their solution demanded united effort.

The new Society would provide an opportunity for such intercourse and exchange of views. It would encourage and assist research, and one of its chief functions would be to encourage the wide dissemination of the information available.

Amongst the aims it had in view might be mentioned:—

(1) The arrangement of lectures, demonstrations and publication of information of service to the public.

(2) The impressing of correct ideas on lighting on children at school.

(3) The giving of advice and information generally in order to ensure the proper application of light in practice.

(4) The adopting of measures rendering easier the introduction of advances and improvements in lighting.

In illustration of the last point Dr. Halbertsma referred to the simplification possible by the standardization of lamps and lighting accessories, the desirability of more rational tariffs for the supply of gas and electricity, and the advantages of more uniform technical conditions of supply.

In pursuing these aims the Society would not be concerned only with electric lighting, but with gas lighting and other illuminants, and with daylight illumination. Such a programme could not be pursued without a central office and permanent demonstration rooms. It would also be necessary for the Society to obtain support for its research work in the form of subsidies from existing commercial and industrial organizations, which derived direct benefits from advances in illuminating engineering. Dr. Halbertsma illustrated possible methods of work by describing what is being done by various bodies abroad, such as the British Illuminating Engineering Society, the French "Société pour le Developpement de l'Eclairage" and the E.L.M.A. Lighting Service Bureau. In Holland the aim would be to combine the chief features of such work, and to operate in close co-operation with bodies abroad interested in the development of lighting. The international aspects of the Society's work would be specially important, as it would have to represent Holland on the International Illumination Commission, thus forming the Dutch centre of contact with foreign countries. During recent years Holland had not participated in such international co-operation, but he hoped that the new Society would soon be able to ensure that Holland occupied a worthy position in this respect.

Following Dr. Halbertsma's address, Mr. Moes, the Chairman, gave a brief account of the immediate steps to be taken in connection with the formation of the new Society. One of its first steps would be to secure someone eligible to supervise its everyday affairs. It was not easy to find a competent person for this position, but they entertained good hopes of finding an eligible future director as a result of advertisements inserted in various trade journals. The future of the Society was dominated largely by financial possibilities. They had every expectation that the necessary funds would be raised, and discussions on this point were now proceeding. Meantime he might mention that Mr. Gorter, the manager of the Museum of Safety, had promised to allow the equipment of the Museum to be used for purposes of demonstration, and that promises of subsidies had been received from several quarters, e.g., from the Society for Industries and the Association of Gas Manufacturers.

The first step appeared to be to establish the Society, and to map out its programme, which, in the initial stages, would have to be on modest lines.

Mr. Van Thienen, who was then called upon to speak, stated that the Factory Department had for a long time felt the need of advice in connection with lighting. He recalled the difficulties which were experienced 30 years ago when provision had to be made in the Factory Acts for a hygienic minimum in factory lighting. This was a difficult task in view of the fact that at that time very limited experimental data were available from abroad, and the making of measurements of illumination was not then an easy matter. The Factory Department anticipated that much good would result from the formation of the proposed Society, and would take a great interest in its future.

After Mr. Moes had expressed appreciation of Mr. Van Thienen's encouraging remarks, the Chairman put the question whether all present agreed to the establishment of the Society of which they would become the founders. All present having signified their approval, the Chairman declared the Society to be established. He proposed that the Society should be governed by a General Council, which should be composed, as far as possible, of representatives of the various firms, institutions and scientific bodies interested in its aims and objects. From this General Council an Executive Council would be elected, and would exercise supervision over current affairs. Meantime it was agreed to elect an interim Council, which would draw up the Constitution and By-laws.

It was agreed that the membership of the interim Council should be as follows: Professor G. Van Iterson, junr. (Member of the Council of the Society of Industries); Mr. Gorter (Engineer and Manager of the Safety Museum); Mr. P. Braam Van Volten (Engineer, Chief of the Coast Lighting Technical Service, and member of the Standing Motor-car Lighting Committee of the Royal Dutch Automobile Club and the Dutch Cyclists' Club); Mr. Terneden (Engineer, President of the Association of Gas Manufacturers, and member of the Dutch Illumination Committee); Mr. Keller; Mr. J. K. Merox (Engineer, Government Adviser of Industries in Tilburg, and Deputy Chairman of the Technical and Economic Association); and Dr. N. A. Halbertsma (Engineer to the Philips' Incandescent Lamp Works).

Indirect Lighting in Factories

It has come to be fairly generally assumed that indirect lighting is not suitable for factories, partly on account of the inevitable loss of light involved in such processes, and also in view of the difficulty of maintaining walls and ceilings in the necessary state of cleanliness. *The Electrical World*, however, points out that judgments of the value of indirect lighting are apt to be affected by progress in lamps and lighting appliances. Before the advent of the gasfilled lamp indirect lighting was not generally regarded as a very practical proposition. Illumination was so low that the loss of light by reflection could not be spared. The advent of the gasfilled lamp, with its higher candle-power, efficiency and brightness, led to a change of view. The great brightness of the filament rendered screening a vital matter, and it was felt that the gain in efficiency rendered indirect lighting more feasible—hence for a time indirect lighting came into fashion, though it was never widely applied industrially. Ultimately what is known as "semi-indirect" lighting proved to be more popular, and this in turn now tends to be replaced by enclosed units of the diffusing type. Another new factor has now been introduced, the growing tendency to make use of illuminations much higher than those previously adopted. At one time 5 foot-candles was considered a high illumination; to-day 10 foot-candles is not unusual, and there are even factories where as much as 10 foot-candles is found. *The Electrical World* contemplates a time when even 40 foot-candles will be a usual figure! If this is so the great rise in illuminations will once more draw attention to the paramount necessity of avoiding glare. Already our standards in this respect have undergone revision. In the words of our contemporary, the "sky" must accompany the "sun" as we approach nearer to daylight intensities, and a bright ceiling will be considered an essential to proper lighting. The illuminated ceiling may be regarded as in a measure fulfilling the functions of the sky, from which a great part of natural light is commonly derived. Even so, one is inclined to doubt whether total indirect lighting will ever become generally popular in factories. It might be suggested that a good form of semi-indirect lighting, or even an enclosed diffusing unit supplemented by a white ceiling above, approaches more closely to average daylight conditions, giving the mixture of direct and diffused light characteristic of the sun's rays, lightly veiled by clouds. But it is doubtless true that the use of reflection of light from walls and ceilings will become much better recognized, both with a view to avoiding glare and also in order to secure soft shadows—conditions, in fact, more closely resembling those associated with well-diffused natural lighting.

The Exhibit of Electric Lamps at the Czecho-Slovak Technical Museum in Prague

READERS will recall that a few months ago we published a short note referring to this interesting collection of lamps. The following account of the exhibits is based on the description kindly sent to us by the Director of the Museum. It will be seen that the collection is exceptionally complete, and there are several interesting features in the way of displaying lamps—notably the arrangement by which the filaments of all lamps are normally brought to a red glow by the passage of a weak current, thus enabling their shape, method of mounting, etc., to be readily seen.

It was originally intended to arrange for the exhibition of all forms of artificial illuminants, but at present, owing to lack of space, only electric lamps are represented.

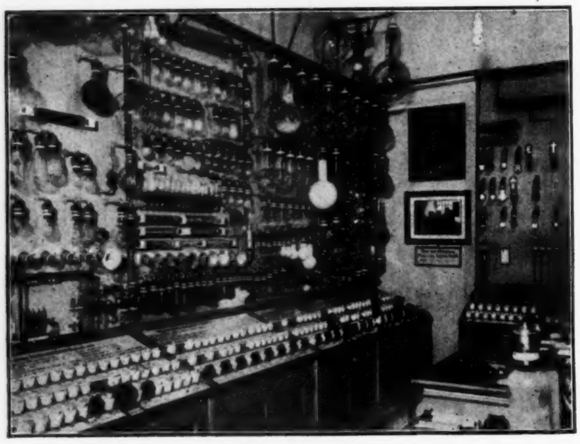


FIG. 1.—Showing method of assembling samples of lamps, the control-switches for each, with appropriate descriptive tablets, being mounted below.

The first exhibit of interest provides a chronological record of the development of the electric incandescent lamp from its beginning up to the present stage. Seven panels are available for exhibits. Amongst the lamps shown there are:—

(*a*) *Carbon-Filament Lamps.*—Some early efforts in carbon lamps made before 1870; Edison's lamp, Siemens's lamp, ancient types, etc.; lamps with metallized filament; and finally such lamps as are still used to-day. Further, the interesting Hopfelt lamp (using mercury), a lamp with two filaments (3 and 16 candle-power) with a change-over switch, and a 200 candle-power carbon lamp for theatre illumination.

(*b*) *Nernst Lamps.*—Original types without automatic lighting and later types, including projection lamps of 600 candle-power.

(*c*) *Osmium Lamps.*

(*d*) *Tantalum Lamps,* including interesting examples of methods of mounting the filaments for 240-volt circuits.

(*e*) *Tungsten Lamps with pressed filament* (e.g., Dr. Just's, Dr. Kuzel's lamps, Fulgura (Bergmann), Osram, Tungsram, Pintsch, etc.). The largest are of 400 candle-power—the special "Lelios" with filament designed to direct the light in one direction.

(*f*) *Drawn-tungsten wire Lamps* (Osram, Tungsram, Wotan, etc.). Wotan-Verico with a bulb of blue glass in order to imitate daylight. Lamps of mushroom shape with a straight wire (Wotan-focus). Various miniature lamps for special purposes, automobile lamps, etc. Round lamp "Vertex," with an interesting method of winding of the wire, and the first lamps with spiralized filament.

The next panel contains the standard types and sizes of lamps now made, comprising standard types in round and tubular-shaped bulbs, and others of various kinds and forms with simple and spiral wire. There are also some special lamps for ornamental, signal, theatrical, and photographic lighting, "Economy" lamps (Philips and Osram, with a condenser), various types for rough service (railway-carriage, workshops, etc.). There is also an interesting lamp with an automatic interrupter in the base (Philips). Here are also lamps manufactured by the following firms: Elektra, Lux, Philips, Osram, Metax, Ferrowatt, Tungsram, A.E.G., Meteor, Pintsch.

(*g*) *Gasfilled Lamps.*—The early types: A.E.G. 1913, Osram, Metallum, etc.; modern standard types with different kinds of glass; the most powerful lamp yet made (73,000 candle-power), and various types of automobile lamps. Here is also a lamp for low voltage (16 volts) with a transformer mounted in the socket.

On the next panel there are, firstly, the normal incandescent lamps for lighting, including the most powerful (10,000 candle-power, Philips), and the projection lamps (100 volts, 6,000 candle-power). The American Mazda lamp (30-volt, 30 ampere, 900-watt), the Philips and Osram projector lamps with a mirror-reflector, reflector lamps (Mazda and Philips), and a lamp for micro-projection.

Almost all these lamps are in a good condition, and it is possible to light them up. Throughout the time during which the exhibition is open the filament of each lamp is subjected to a low current, so as to glow red, and thus be easily visible. The different voltages necessary for this purpose are furnished by a special transformer made and presented by the firm Ceskomoravska-Kolben Co. (Prague). Each lamp has its own controlling switch, the most important dates being indicated by appropriate inscriptions. About 600 lamps are thus installed. Every kind of incandescent lamp, its history, properties and method of use are described on the tablets of the various panels. On the other wall of the room there are four panels all of the same size. On the first panel are the Neon ("Glimlight") lamps (Pintsch, Osram, Philips): also lamps operated by an electrical discharge through rarefied gas (Geissler); neon lamps for high voltages; experiments showing fluorescence of various materials; and the neon rectifier for 0·2 ampere (Pintsch).

On the next two panels are the mercury-arc rectifier and lamps; the ordinary mercury-tube lamps; the silica lamps for electro-medical use; a mercury-arc rectifier for 5 amperes is in service; also examples of tungsten-arc lamps (Osram and Philips).

On the last panel are Crookes' and Röntgen's tubes, operated by a high-tension discharge. Also a Crookes' lamp containing various kinds of crystals which glow in the different colours.

The table in the centre of the room contains ornamental lamps with bulbs of different colours and forms. Here are also shown models illustrating the process of

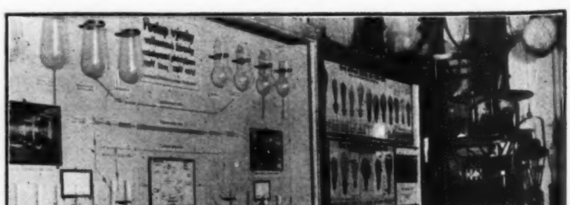


FIG. 2.—A corner of the room showing special exhibits, including demonstration of method of manufacturing incandescent lamps, and also various arc lamps, etc.

manufacture of incandescent vacuum and gasfilled lamps (presented by "Electra," Prague), various special lamps and experiments, and a collection of the different types of valves for wireless service (Electra, Philips, German, French, English, American, etc.); and two electron-rectifiers (Philips 1·3-ampere, A.E.G. Rama 5-ampere).

The other two walls of the room are given up to the electric-arc lamps for direct and alternating current. Here are early forms of arc lamps with and without automatic regulation, Krizik's lamps, and modern types.

On the wall is a box illustrating the influence of the voltage on the intensity of light of a carbon lamp and metal-lamp, and another box which illustrates the colour of the light of the carbon, vacuum-metal, gasfilled lamp, and a lamp with "daylight" blue glass, and the possibility to distinguish the different colours in the light of these sources.

Experiments with the Integrating Photometer

SEVERAL papers dealing with the integrating photometer (Ulbricht sphere) have recently been read before the German Illuminating Engineering Society, and are summarized in *Licht und Lampe.*

A communication by G. Gehloff summarizes results obtained with a special form of enclosure having 14 surfaces. This form of box with corners is naturally simpler to construct than a sphere; yet it was thought that, owing to the number of surfaces, it would approach it sufficiently closely in actual operation. The distance across between surfaces (the section was octagonal) was only 50 cms. Experiments were made with a 60-watt gasfilled lamp with spiral filament in one plane, a vacuum type 32-H.K. lamp with vertical filaments, and a gasfilled lamp with opal bulb. These were compared against each other, and the experiments suggest that the error involved was less than ± 2 per cent. This is considered a good result in view of the fact that exact determinations of spherical candle-power of gasfilled lamps are very difficult to make by the Rousseau method; variations in candle-power of at least 5 per cent. are encountered when the lamp is rotated. The above error could be accounted for largely by the ordinary sources of error recognized to exist in an Ulbricht sphere, such as the selective action of the white interior coating. This was the probable explanation of most of the error found with the vacuum lamp. It was found that a material improvement was obtained by placing in front of the window a piece of frosted glass; this was preferable to opal glass.

It appears that with an apparatus of this type ordinary lamps can be compared with sufficient accuracy. But the correctness of the apparatus with highly asymmetric surfaces, such as arc lamps or incandescent lamps equipped with reflectors, is more problematical and remains to be ascertained.

In the discussion reference was made to experiments with a somewhat more elaborate integrating photometer, having 20 surfaces. It appeared, however, that results with this apparatus did not represent any advance over those obtained with the integrating photometer with 14 surfaces.

Another communication by Arndt deals with the effect of the size of the observation window, which cannot be strictly regarded as a point source. It is shown that in order that the resultant error may reach 5 per cent. the ratio distance of photometer from observation window/diameter of observation of window must be at least 1·8. This means that with an observation window 9 cms. in diameter the distance of the photometer would have to be within 16 cms. to produce 5 per cent. error. In practice it would be inconvenient to bring the photometer as near as this, so that this source of error is not of much consequence in practice.

A third communication by Dr. H. Lux describes an accessory device which enables the integrating photometer to be applied to gas lamps. The chief difficulty has always been the maintenance of air-conditions similar to those occurring when the lamp is burned in the open. This is got over by introducing two new elements, a tube (at the base of the photometer) through which air can be supplied under pressure and a special observation window. The observation window can carry strips of gold leaf or smoke may be injected; the pressure is regulated until the smoke is neither sucked into the photometer nor expelled, and the test is very sensitive. Alternatively the movement of the small strip of gold leaf may be observed. If there is no sign of motion it is inferred that conditions resembling those when the lamp is burned in the open are reproduced.

The New Cosmic Rays

With further reference to our note on the above subject in our last issue we observe that a very lucid account of the researches in this field has been contributed by Professor R. A. Millikan to *The Scientific American.* In the first place it is to be noted that the existence of such rays is not entirely a recent discovery, as is commonly assumed. As far back as 1905, McLennan and Rutherford showed that the leak in an entirely enclosed electroscope was diminished 30 per cent. when the apparatus was surrounded by a wall of lead two inches thick. It was inferred that this leak was at least partially due to the existence of obscure rays capable of passing through 1 cm. of lead and ionizing gases. The relation between penetrating power and altitude was studied by means of balloon experiments by various Swiss physicists during 1910-1911. In 1915 experiments on similar lines were commenced by Professor Millikan. These were interrupted by the war, but in 1921 the work was resumed and measurements were obtained, as we have previously mentioned, at altitudes up to ten miles. These showed a progressive increase in the ionizing effect as the altitude increased, so that the effect of absorption in passage through the atmosphere was evident. Experiments made in 1923 on the top of Pike's Peak showed increased radiation, but as the leaks were reduced by a local snowstorm the radiation which was relatively "soft" was inferred to be of a local character. We come next to the most interesting part of the researches, on which the identification of these "cosmic" rays chiefly rests. The balloon experiments had been suggestive in showing that the radiation did apparently increase distinctly with altitude, though the absorption of even 10 miles of atmosphere was relatively small. From these and other experiments the conclusion was drawn that if the permanent leak on the electroscope is due to "Cosmic Rays" emitted from some distant point in space they must be of a very much more penetrating character than had been hitherto supposed. This point was tested by experiments on apparatus sunk in the waters of a mountain lake, Lake Muir, 11,800 feet above sea level. The discharge decreased uniformly as the depth of immersion was increased to 50 feet. There was evidence of radiation so penetrating that it required a depth of 73 feet of water (equivalent in absorbing power to six inches of lead) before the radiation causing the leak was completely checked.

Confirmation was obtained by experiments under similar conditions in another mountain lake in a different district, i.e., Lake Arrowhead, in the San Bernardo mountains, 5,725 feet high. It was then found that by sinking the apparatus to a depth of six feet results identical with those obtained in Lake Muir at a depth of 23 feet were obtained. The difference in depth of water, translated into equivalent depth of atmosphere, exactly corresponded to the difference in altitude of these two lakes in widely separated districts. No change in the radiation at midday and midnight was observed, and it is therefore inferred that the rays are independent of planetary motions, and shoot through space equally in all directions.

Illumination and Visual Capacities*

IN the introduction to this report reference is made to the growing recognition of the need for active and extensive research work on the physiology of vision. This has been rendered specially evident by the requirements of the combatant services; for problems of vision play a much more important part in warfare than in the past.

This report was accordingly prepared by Mr. R. J. Lythgoe at the request of the Council. It contains a general survey of researches bearing on the relation between Illumination and Visual Activities, and many hundreds of references are tabulated in the appendix, occupying 14 pages. This is probably the first time that a comprehensive record of experiments in this field has been assembled. It may come as a revelation to many to find that so much work in this field has been done. But as many of the researches were made from widely different standpoints it is not unnatural that there is often difficulty in correlating results and drawing definite conclusions as to their bearing on illuminating engineering.

The work is grouped under nine main headings which are as follows: (1) The Influence of Different Intensities of Illumination on Visual Acuity; (2) The Effect of Varying the Character of Illumination on Visual Acuity; (3) The Discrimination of Shapes and Differences in Brightness; (4) Adaptation as a Factor in Visual Discrimination; (5) The Influence of Lateral Illumination, including "glare" on Visual Judgments; (6) The Speed of Retinal Impression, with Special Reference to Telegraphic Signalling and to Lateral Illumination; (7) The Influence of Illumination on the Discrimination of Colours; (8) Visual Fatigue; and (9) Methods and Apparatus.

Experiments on the influence of illumination on visual acuity, by the aid of standard test objects, were commenced many years ago. Investigators have invariably found that higher illuminations tended to improve visual acuity, but naturally the precise effect has varied according to the method of test. Attempts have been made to express the relation by a formula, one of the simplest relations (applying, however, only for relatively weak illuminations) being that visual acuity varies as the square root of the illumination. One important point revealed is the influence of illumination on visual defects. Thus Ferree and Rand have found that astigmatism is most noticeable at low illuminations.

The above tests depended essentially on the recognition of objects. A number of tests of the effect of illumination on speed of reading have also been made. Thus Richtmyer and Hess found that speed of reading increased rapidly with higher illuminations up to 0·5 foot-candles, after which there is little change. Luckiesh, Taylor and Sinden, however, using Old English characters which are more difficult to recognize, showed the importance of contrast. For high contrasts (black on white) speed of reading tends to assume a constant value above 10 foot-candles while for low contrasts it continues to increase up to the highest illumination used (25 foot-candles). On the other hand French has found that apparently increasing the illumination by a thousand had no appreciable effect on the accuracy of contact setting of a vernier.

The variation in results in regard to effect of colour of light on visual acuity are much greater. Older investigators such as Macé de Lépinay believed that visual acuity depends chiefly on the more refrangible rays. Others have found that visual acuity appears to be lower for all colours than for white. Others again suggest that the blue-green end of the spectrum is best for very close work, but not so good as red for the illumination of patterns to be distinguished at a distance. Bell found that for equal brightness a mercury-vapour lamp yielded a higher visual acuity than a tungsten lamp, while Luckiesh has found that, in general, monochromatic light is better than a mixed light source (such as daylight) and that amongst monochromatic lights, yellow is superior.

Much work has been done on the discrimination of shapes and of differences in brightness. Fechner's Law breaks down both at high and very low illuminations. An interesting result found by French is that power of distinguishing brightness is inversely proportional to the square root of the diameter of the object. A somewhat unexpected result recorded by this observer was that the *fovea*, especially the very centre of it, is relatively insensitive to differences in contrast. (This would seem to suggest the adoption of a relatively large angular diameter for photometric fields.)

There are records of various researches on retinal adaptation, specially interesting being the experiments made on night pilots in the flying service. An individual's visual acuity in daylight or dim light is no criterion of his light-sensitivity. Size of pupil has a material effect on visual acuity. According to Uthoff, a certain intermediate pupil diameter can be found giving best results at high illumination, whereas at low illuminations the larger apertures gave the best results. Speed of retinal impression also plays a part in many operations of the eye. The time required for the recognition of an object naturally depends both on its size, brightness and contrast with surroundings. Researches in this field have a special bearing on signalling operations. Thus Forsythe has found that the best time ratio for dot, dash and space in telegraphic light signalling was 1 : 4 : 3; and also that at a distance of 2,700 yards the minimal time for a four-part signal is about 1·6 secs.

The influence of glare on visual judgments has been examined in considerable detail, reference being made to the familiar researches of Cobb, Nutting, and others. Bordoni reached the conclusion that luminous intensity of the source as a whole, rather than brightness, is the factor which most influences the perception of differences in brightness. From this standpoint frosting a lamp appeared to have little effect, yet it is unquestionably preferable so far as the comfort of vision is concerned. Bordoni emphasized the desirability of keeping lights well out of the range of vision, an angle of not less than 30° being approved. In these researches, as in the case of experiments to determine the relation between intensity of illumination and visual acuity, it would appear that effects are most pronounced when the contrast between a test-object and the background is relatively small. In such circumstances the effects of glare are much more marked than when an object is so easily distinguished as to be visible under almost any conditions. A sub-committee of the American Illuminating Engineering Society has done a considerable amount of work in distinguishing different forms of glare. Apart from the "blinding glare" of very bright objects in the direct range of vision, "dazzle glare" may arise from "adventitious light so refracted and scattered as not to form part of the retinal image," whilst "veiling glare" is due to "light uniformly superimposed over the retinal image, thus reducing contrasts, and hence the visibility." Doubtless the latter form of glare will be much affected by the condition of the observer's eye.

Other researches deal with the influence of illumination on discrimination of colours, speed of retinal impression, and visual fatigue. It is somewhat remarkable that there is scarcely any work on the latter subject except that relating to colour vision. The effect of exposure to white and coloured light in altering impressions of colours has been studied by many observers, notably by Burch and Edridge Green.

Owing to the wide range of matter dealt with it has only been possible in this note to give a very general idea of the contents of this report. It forms a most valuable compilation. One would like next to see these results critically analysed with a view to establishing so far as possible certain definite principles for the guidance of illuminating engineers.

* Report of the Committee upon the Physiology of Vision (Medical Research Council); published by H.M. Stationery Office, 2s. 6d. net.

POPULAR & TRADE SECTION

COMPRISING

**Installation Topics—Hygiene and Safety—
Data for Contractors—Hints to Consumers**

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

Wired Furniture

By FLORENCE G. HODGE

(Communication from the E.L.M.A. Lighting Service Bureau.)

ELECTRICITY and furniture may appear at first sight to be no more than third cousins very much removed; further inspection, however, reveals a definite and close relationship. The recent publicity given to the Electricity Bill has paved the way for an open-minded attitude towards electricity on the part of the man in the street which promises well for the eager acceptance of a great service, provided goodwill is established on practical and economical lines.

Perhaps the most acute problem the modern home has to face at the present time is that of domestic labour; servants are hard to get, and still more difficult to keep, and the woman of to-day is faced with the prospect of being her own house-parlourmaid and cook or reverting to hotel life. It is here that electricity steps in through the medium of furniture.

The old idea of buying furniture *en suite* is already too old to live and the practical hygienic needs of 1926 show themselves in the purchase of pieces which take their own particular place in the home and justify their position by service and not so much mere floor space. A piece of furniture can be turned into an electric maid with the help of the furniture designer and the electrician.

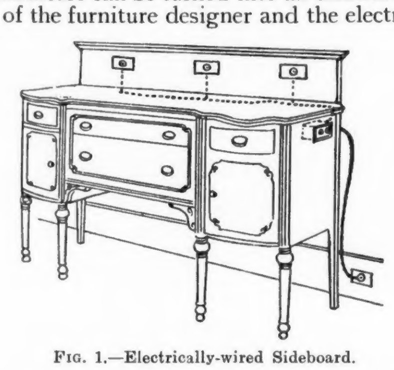


FIG. 1.—Electrically-wired Sideboard.

Sideboard.—Breakfast straight from the sideboard to the table. Bacon, toast, coffee, always ready and hot, even for the last riser. These are the joys of having the dining-room furniture wired. By the means of two or three small plugs let in the back of the sideboard, these again connected to one main plug in the skirting board, it is possible to operate small electrical appliances sufficient to cook and keep a meal hot. There is no disfigurement or damage to the sideboard itself; it only becomes more than ever indispensable in every home. Fig. 1 illustrates such a sideboard.

Dining Table.—Those who have already enjoyed electric appliances on the dining table itself will welcome the freedom thus afforded from the inconvenient trailing flex from the wall plug to the table. As an alternative or addition to the wired sideboard a plug may be inserted in the table, as shown in Fig. 2, and connected to a floor plug under the table. This table plug is equally serviceable after meal time for portable lamps.

Dressing Table.—To many women comfort counts as much as service, and in the bedroom electric light and wired furniture form an ideal combination for those whose imagination can visualize the possibilities. Bad light in the bedroom, especially at the dressing table, is

FIG. 2.—Electrically-wired Dining Table avoids trailing flexes.

irritating. It is not easy to dress comfortably before a mirror in which is reflected a face with a shadow thrown across it, a catastrophe which is only to be expected when the sole light provided in the bedroom is a central light, very poorly diffused, and when facing the mirror it is inevitable that all the light is on the back of the head and none on the face. There is no need to "stand in the light" if the dressing table is electrically wired. Brackets fitted with small lamps and shades easily attachable to the mirror can be obtained. Flexible wires from both brackets meet at the back of the dressing table and connect to a plug in the skirting board. Fig. 3 shows this arrangement together with a plug at the side of the dressing table for curling irons, vibro massage, etc., while Fig. 4 in greater detail shows the fixing of the lighting bracket. Apart from the ideal light thus

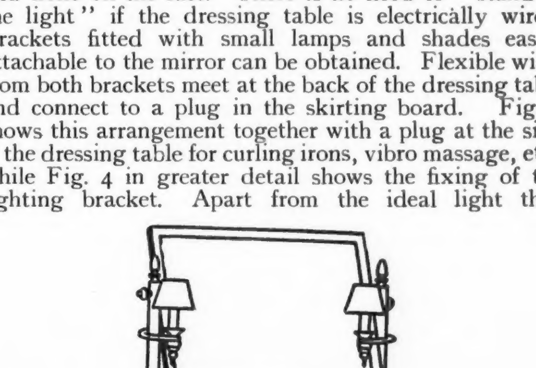


FIG. 3.—Wired Dressing Table and Lighting Brackets.

obtained, there is the additional joy of being able to move the dressing table to any other position in the room (provided there are other wall plugs) a step which is made very inconvenient with the ordinary arrangement of lighting points.

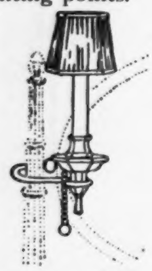


FIG. 3A.—Detail of Lighting Bracket showing the method of fixing.

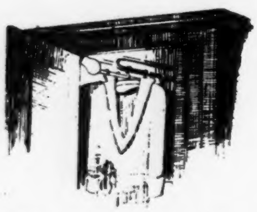


FIG. 4.—Wardrobe automatically switches on light when door is open.

Wardrobe.—To talk of a cheap luxury may sound paradoxical, but the combination is found when the wardrobe is wired. It is easily possible to wire this piece of furniture in a very simple way and install a low-wattage lamp just inside the door controlled by a switch which operates with the opening and closing of the door. To call this luxury "cheap" is justified when it is pointed out that it does not cost more than 1s. per year. Once having experienced this pleasure it would be an easy matter to convince the housewife that the same arrangement is indispensable in her linen and store cupboards. So much for the practical service that electric light can give when used in conjunction with furniture. There remains the service that light itself performs as a means of increasing the artistic value of furniture in the home. To all interior decorators the relation between furniture and lighting effects and fittings are realized, but too seldom is this fact appreciated by the owner himself. Glaring, harsh light from exposed, clear-glass lamps have often ruined the effect of an interior furnished with antique pieces of great value. It needs the lighting artist to point out the difference in the appearance of furniture when soft, mellow light is reflected in the shining surface of age-old wood. Good furniture deserves perfect lighting conditions. The subject is a vast one, and space only permits one short word of advice. It is as well to remind the housewife to take as much care in her lighting effects as she does of her furniture; money that she spends on polish, and this is not inconsiderable, may be as much or even more, than the current used to light the lamps which show it to the best advantage. She is a wise woman who realizes the true value of both.

Gas and Electricity: Showrooms and Service

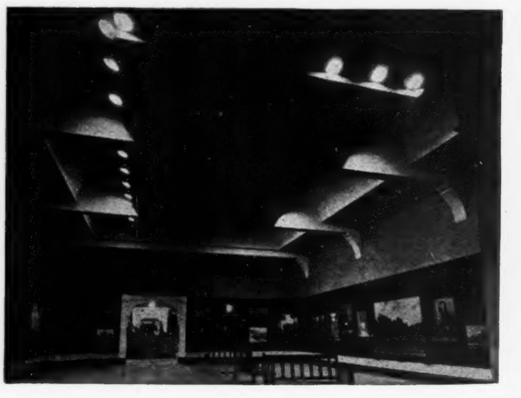
In an editorial note on the above subject *The Electrical Review* points out that developments taking place in the gas industry are of considerable interest to electrical engineers. "Electrical men cannot afford to be so taken up with the Parliamentary proceedings respecting the Electricity (Supply) Bill as to overlook what had been occurring in another room of the House of Commons where the Bill promoted by the Gas Light and Coke Company has been under consideration. This particular measure deals with the finances of the Company and provides for a minimum dividend, and among other evidence given in support of it was that of the Governor of the Company, Mr. D. Milne Watson."

It is recalled that the Gas Light and Coke Company has an issued share capital of 33½ million pounds sterling, and in order to meet new demands it is proposed to spend in the near future £3,250,000 on the extension of gasworks, £1,500,000 for mains, £1,500,000 for meters and stoves, and £750,000 for showrooms. These sums are for the purpose of creating new business. It was pointed out that the fact of "electricity having been taken up by the Government had been a most serious matter for gas stocks generally," though what had been happening before the Parliamentary Committee on the Electricity Bill had removed immediate anxieties.

In this connection our contemporary remarks: "We have no wish for unfair competition to be introduced for superseding gas—we can leave the two agents to engage in a natural contest, knowing that there is at present plenty of room for both, and that ultimately the fittest will survive. But we do wish electricity to put forth a worthy effort in the competition, and its votaries in the London area would be well advised to ponder over the intention of the aforesaid gas company to spend a large sum on stoves and £750,000 upon new showrooms. . . . Electricity supply interests should indulge in serious heart-searching to see whether they are pursuing a sufficiently enterprising policy. The gas company's showroom programme had only just begun, and the expenditure of three-quarters of a million has been calculated for a period of eight years, and upon the basis of past experience. We should like to know that the companies and local authorities engaged in electricity supply business in the same area had prepared a combined scheme to do the same thing on a large and well-thought-out plan covering all their areas, for we thoroughly believe in the showroom as a business-getter. London has some excellent impressive halls at Hackney and Croydon, and some areas have a number of small displays of a suitable kind, but there is room for large developments in other parts, and we could wish that London authorities could adopt a common up-to-date policy in this matter."

Lighting Art Galleries

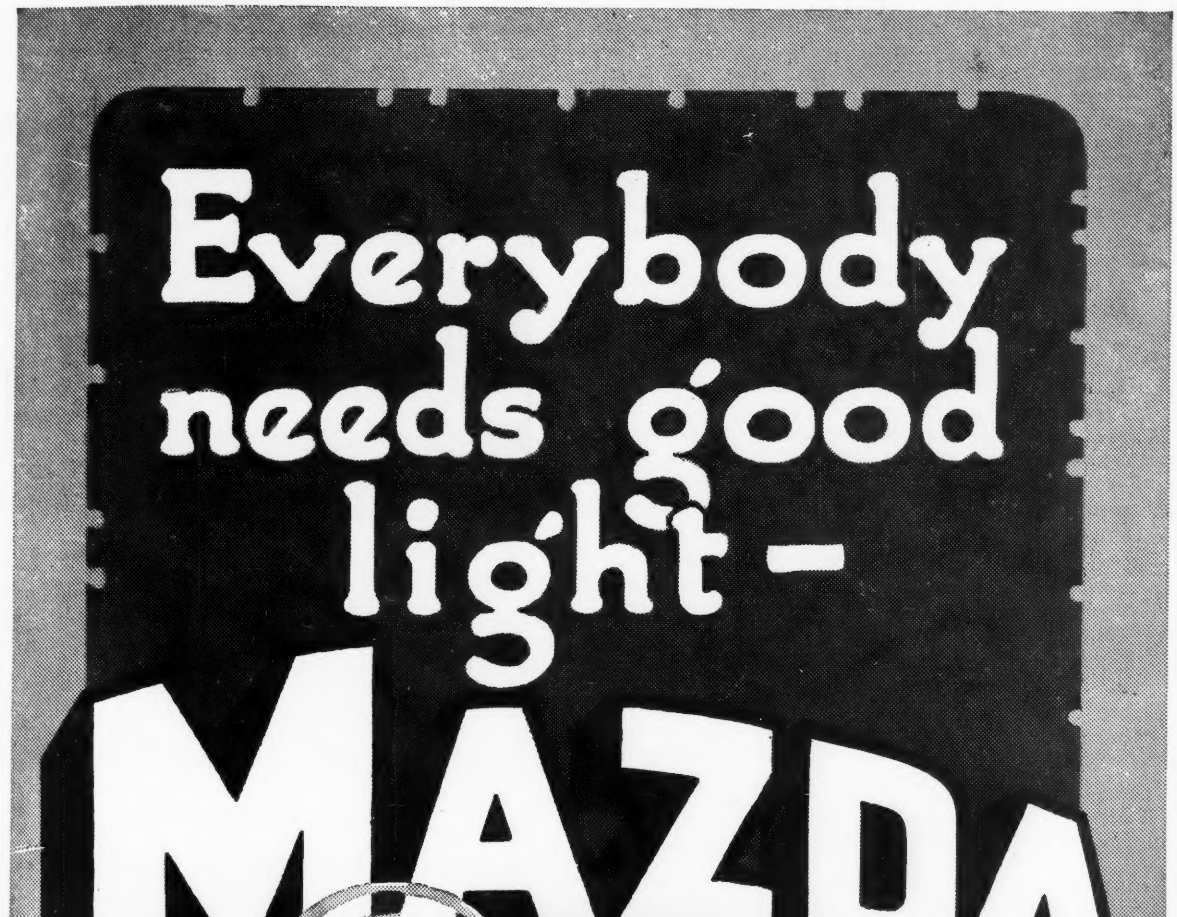
In our last issue we referred to the problem of arranging the lighting of picture galleries in such a manner as to avoid inconvenient reflections of bright objects in the glazed surfaces of pictures. With ordinary natural lighting from skylights this is not a very easy problem. It is, however, sometimes easier to devise the artificial lighting in such a way as to illuminate the surfaces of pictures brightly and at the same time leave the centre of the room, where people congregate, more subdued.



New Zealand and South Seas Exhibition, Dunedin: Art Galleries lighted by the "GECoRAY" system.

The accompanying illustration, furnished by the General Electric Co. Ltd., showing the method of lighting applied in the art galleries at Dunedin, New Zealand, is interesting in this connection. It will be observed that the lamps and reflectors are recessed at either side of the room, so that the rays are partially screened from the centre.

This seems a step in the right direction, though it is evident that the centre of the floor is still comparatively brightly lighted. But for reasons explained previously it does not seem likely that very subdued lighting in the centre of the room would be popular since visits to to picture galleries are semi-social events, and people like to be able to see each other clearly. The best that can usually be done is to tone down the central illumination so that images in glazed surfaces are at any rate less conspicuous than they would otherwise be.


Everybody
needs good
light -
MAZDA
Lamps
ensure it
B T-H
The British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2
2532

The Sheringham Daylight

An Interesting New Development

DURING a recent visit to the showrooms of the Sheringham Daylight Co. Ltd. we had an opportunity of inspecting a promising new development. Most of those interested in "artificial daylight" systems have come to recognize the need for gradation in correction. There are some forms of work, e.g., the precise colour-matching operations carried out by dyers, which demand the highest possible accuracy in correcting the light from a gasfilled lamp. But there are other cases—much the more common—where the absorption of light involved in this accurate imitation of daylight and the "cold" effect of such highly corrected light, are great drawbacks and where a smaller degree of correction is permissible. The new unit is designed to meet requirements in such cases as this.

It will be recalled that the fundamental principle of the Sheringham Daylight is the correction of artificial light by reflection off an extensive over-reflector, on the inner surface of which a correcting pattern in ultramarine and emerald, with a small mixture of yellow, is painted. The bulb of the lamp is encased in a silvered bowl which directs all light upwards, and the Sheringham Daylight for colour-matching purposes is thus an indirect unit.

The new correcting unit about to be introduced is based on direct lighting. The bulb of the gasfilled lamp is not encased, but is allowed to shed light downwards. The correction is applied by merely equipping it with a reflector of the ordinary type, except that the inner surface is coated with a Sheringham pattern. The light directed downwards thus consists of two components, uncorrected direct light from the gasfilled lamp and light reflected downwards from the coloured surface of the reflector. The result is a light which, to the eye, bears a good resemblance to average daylight—probably intermediate between direct sunlight and light from a white sky—and which, while naturally inferior to the Sheringham Daylight proper in accuracy of colour-revealing, yet causes colours to appear sufficiently near to those seen by daylight for many practical purposes.

It is to be noted that this effect could not be obtained by merely removing the silver bowl used with the lamp in the ordinary Sheringham Daylight. The combination of direct and reflected light in this case would be much further removed from the colour of daylight. In the correcting units the reflector has been coated with a new system of colours, one of the chief distinctions being the lighter tone of ultramarine adopted. We understand that the choice of colours has been made with great care in order to ensure that the correction, whilst less exact, is still uniform throughout the spectrum. We were also informed that the loss of light occasioned by the colouring is not more than 10 per cent—which is effectively demonstrated by two cabinets, one containing lamps in ordinary reflectors with white enamelled surfaces, the other lamps of exactly similar wattage and reflectors of similar shape, but with the correcting inner coating.

One recommendation of the new device is its simplicity, and another the fact that it can be readily applied to any existing lighting system. There are many fields in which the resemblance to daylight, obtained with only a small sacrifice of energy, should be welcome. Many shop windows devoted to coloured goods, florists, drapers, etc., could probably utilize this form of approximate artificial daylight, and the same might apply to art galleries.

It is also believed that the colour of the light will be found very suitable for work involving close vision. We understand that the new reflectors will be inexpensive and will be available in a great variety of forms.

One question of obvious interest is the permanency of the colours. It is expected that in ordinary circumstances a reflector will last for several years before the coating requires renewal, but this can be cheaply done. There should also be no difficulty in providing the reflector with a clear glass underneath if desired.

Exhibition Lighting in New Zealand

An example of spectacular lighting in distant parts was afforded by the "New Zealand and South Seas Exhibition," recently held in Dunedin, New Zealand. A view of the Grand Dome is shown in the accompanying illustration, and we have received from the General Electric Co. Ltd. some particulars of the methods of lighting. The illumination of the grounds and buildings

The Grand Dome, New Zealand and South Seas Exhibition, Dunedin.

was carried out largely by means of Osram colour-sprayed lamps. There were, for example, 900 white-sprayed lamps and 200 of orange, green and flame-tint colouring. There were also over 5,000 other Osram lamps used, and 2,500 feet of "Fairyland" strip. Considerable use was also made of spotlights, floodlights and reflectors. The Art Galleries at the Exhibition, referred to elsewhere, were illuminated on the GECoRAY system.

Limits to Intensity of Illumination

One often hears it said that there is no practical limit to the intensity of illumination likely to be appreciated by the eye, provided that glare is absent. A visitor from India to whom we mentioned this view dissented. Such an opinion, he averred, could only arise in countries where the sun is usually veiled by clouds, and where even in summer its full power is not experienced. In India the problem is usually to mitigate the extreme brilliancy of sunlight, and in drawing offices much ingenuity has to be exercised in toning down the brightness during the hot season. From his own experience he considered that about 10-15 foot-candles was the comfortable limit by artificial light. In daylight a higher range can be tolerated, but he had found between 100 and 200 foot-candles excessive. This expression of opinion is worth consideration in view of the prevailing tendency towards higher illuminations.

Naturally the provision of illumination for close work is something different from the lighting-up of objects, on the stage or in a shop window, which are observed from a distance. No doubt the range of useful illumination here is higher. But when the eye is steadily concentrated on a limited area it does seem possible that unduly high illuminations might prove fatiguing.

A New Portable Universal Photometer

We notice that in *The Revue Optique* Prof. A. Blondel has recently described the new portable illumination photometer recently devised by him. Readers may recall that Professor Blondel contributed an illustrated description of the apparatus to this journal last year.* It is specially adapted for measurements of brightness and makes use of an artificial pupil allowing Rayleigh's method to be applied with the use of a standard comparison source which takes the place of a point of light.

* *The Illuminating Engineer*, Vol. xviii, p. 237.

Gas Lighting at Bouverie House

In our last issue we referred to the new premises of Messrs. Benn Bros. & Co. Ltd. at Bouverie House, but we omitted to draw attention to one interesting point—the fact that while the offices of *The Electrician* and other sections of the building are appropriately lighted by electricity *The Gas World* offices are lighted by gas. Otherwise the methods are substantially the same, in fact the installation shows how similar effects can be achieved with both illuminants. For the most part the rooms are lighted by centrally suspended bowls containing superheated cluster burners with four No. 2 mantles. The lamps are operated by a special tumbler

Semi-indirect Gas Lighting in the Offices of *The Gas World* at Bouverie House.

switch in conjunction with a distant lighting device. The candle-power of each of these four mantle fittings is approximately 160, so that ample illumination should be available. In another room a system of bracket lighting has been adopted, the fittings being of the "Elite" type, also under direct control. Each bracket has two burners giving approximately 75 candle-power each. Bouverie House also makes use of gas in its staff restaurant kitchen. The whole of the arrangements were planned out by the Gas Light & Coke Co. with the object of illustrating all the latest methods and providing conditions of lighting suitable for the offices of a leading gas journal.

Electricity and Gas Opportunities for "Allied Services"

Sir Philip Cunliffe-Lister, President of the Board of Trade, in inaugurating important extensions in the Gas Light and Coke Co.'s station at Fulham, recently referred to the great place filled by the gas industry in the domestic life of the country. The capital invested in the industry amounted to £170,000,000, and it had over eight million consumers. In many ways it was expanding beyond its original purpose of furnishing light and heat. He would be a very superficial observer who would say that gas would give way to electricity. It was true that gas and electricity competed to some extent in some of their spheres. But the wiser and the longer view must be that in the great field which lay before them they would not be rivals competing for a static market, but allies in a progressive service. Gas was one of the great key industries of the country and its hundred and one by-products formed a happy hunting ground for scientists and chemists. Sir Philip also alluded to the Gas Light and Coke Co. as being one of the pioneers in profit sharing and co-partnership.

How Nature Lights the Sea

A very fascinating paper under the above title was recently delivered before the American Illuminating Engineering Society by Mr. William Beebe, who described some of his experiences on the expedition of the "Arcturus" to the South Seas. The "Arcturus" was fitted up as a great floating zoological laboratory, and many interesting forms of marine life were identified and studied. The diversity of creatures met with at great depths was indeed bewildering. Fishes would come up with enormous feelers developed from the dorsal fin and other parts of the body and invariably these were blind. What was specially singular was that many of these fishes which were blind and had feelers yet exhibited luminescence. Why should fish develop spot organs throwing light of various colours and yet be without eyes to see them? One often reads of the eyes of animals shining in the dark. Such eyes cannot of course "shine," unless there is some light at the back of them. Fish were, however, discovered whose eyes did actually shine. At the back of the eye, and usually a bit below it, there was a brilliant organ, often developing light of a pink colour, provided with blinkers which concentrated the light on the eye. This light did not apparently blind the fish, which could identify others swimming towards it.

There were also many varieties of surface "lantern" fish, the bottom of which were covered by many minute light-yielding organs so that the surface looked like a solid sheet of light. Observations suggested that this light was possibly useful in attracting small organisms on which the fish fed. Along the side of the fish there were also a few luminous spots, always arranged in the same pattern. It was suggested that these might be "recognition signals" enabling each fish of the kind to recognize its species.

A third type of light consisted in three to five brilliant luminescent scales—in the males above the tail but in the females below it. This apparently might be regarded as a device enabling fish of different sexes to find each other—for one fish to find its mate. Other strange forms of fish consisted in little more than an enormous mouth, with just enough tail to push him around. A very curious appendage, luminous on the tip, apparently served to attract prey. Strange to say the teeth of this fish were also luminous.

Lastly Mr. Beebe described a curious creature which protected itself in a way exactly the opposite to that practised by the cuttle fish. The latter, as is well known, makes itself invisible by ejecting a dark cloud of sepia. This other little shrimp-like creature proceeded on the opposite principle. When first observed there was no sign of luminescence. Presently a little trickle of light was seen coming from the body. This increased and grew in diameter until the whole of the jar of water in which the creature was confined became brilliantly luminous. In other words it protected itself in a way exactly converse to that of the squid—by surrounding itself by a luminous cloud which apparently dazzled its enemies and afforded it time to make its escape.

Luminous Clouds

Whilst, during a brilliant dawn or sunset, clouds that are apparently highly luminous may be observed, it is understood that the brightness of these clouds is merely a result of illumination by the sun-rays, though the way in which the light travels may be inconspicuous to the observer. But according to some observations by Dr. G. M. B. Dobson in a recent Halley lecture ("The Uppermost Regions of the Earth's Atmosphere") highly luminous clouds may sometimes be observed at night, and the source of their brightness is more problematical. Vivid striking photographs of such clouds were reproduced. These luminous clouds are said to have been discovered by Professor Ceraski, of Moscow, in 1885. They have been ascribed to the presence of minute dust in the atmosphere and to volcanic action. According to the latest theories, this explanation appears doubtful, but the exact cause of the phenomenon does not seem to be clearly established.

Some Beautiful

The illustrations below show views of three sections of the recently remodelled showrooms of the Gas Light and Coke Company at Horseferry Road. These showrooms contain some particularly beautiful examples of modern gas lighting fittings.

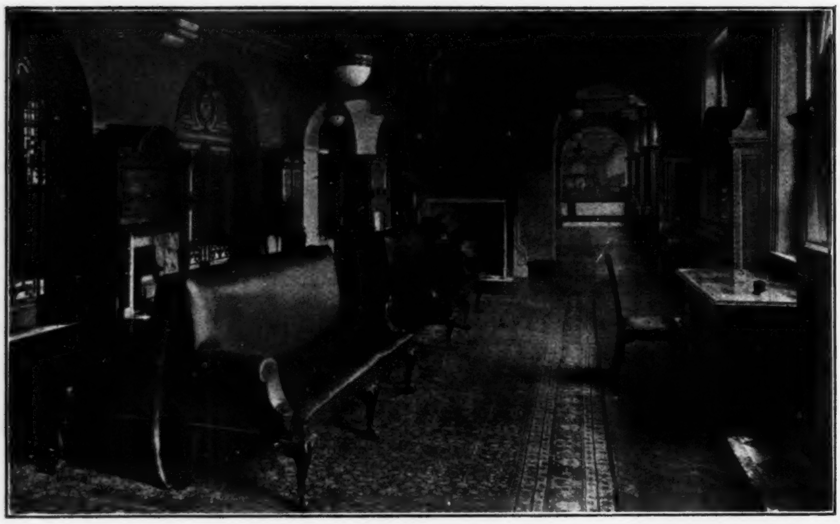


FIG. 1.—Large Reception Lounge showing semi-indirect gas lighting pendants designed to harmonize with the surrounding decorations.

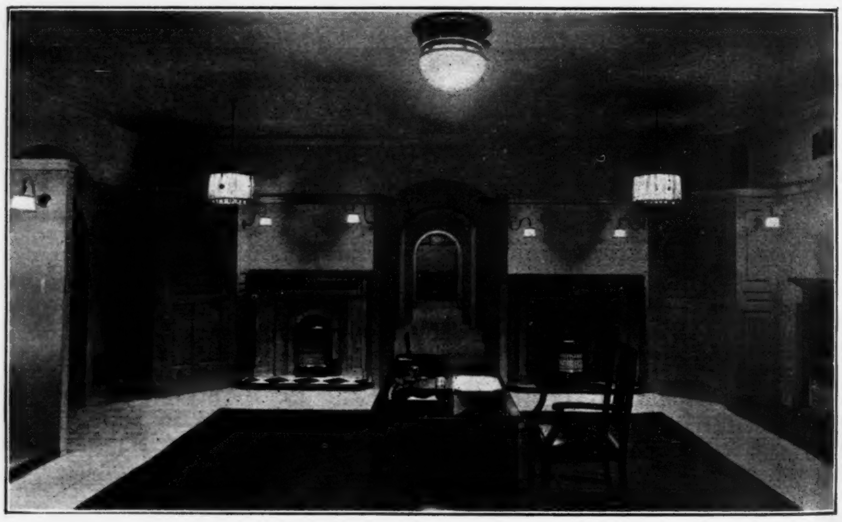


FIG. 2.—Central Reception Room in Showrooms, showing gas ceiling light and silk-shaded gas pendants and brackets.

FIG. 3.—Corridor leading to the Model Rooms, some of which are shown on the next page. The silk-shaded gas brackets are on simple but artistic lines.

Gas Lighting Fittings

Views of some of the Model Rooms in the Showrooms of the Gas Light and Coke Company at Horseferry Road, showing some very attractive examples of pendants, brackets, hall lights, standard lamps and table lamps.

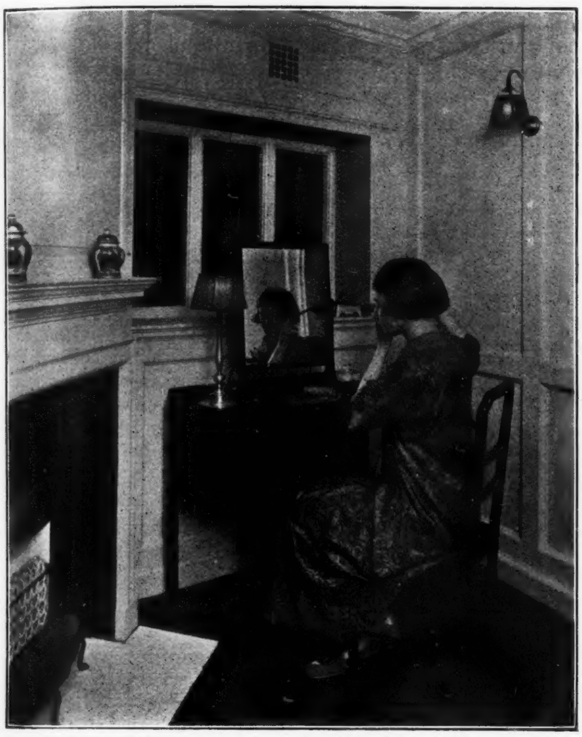


FIG. 4.—Bedroom, showing gas bracket and gas table lamp.

FIG. 5.—Dining Room, showing gas pendant and gas bracket.

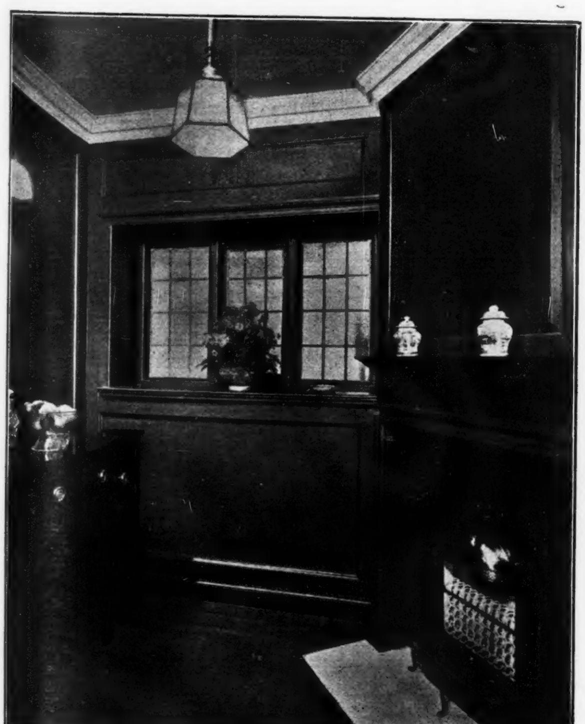


FIG. 6.—Boudoir, showing standard gas lamp and gas bracket.

FIG. 7.—Entrance Hall, showing gas hall light.

The Relation of the Illuminating Engineer and the Architect

AT a recent meeting of the Michigan Section of the American Illuminating Engineering Society, Mr. W. G. Malcolmson, one of the leading architects in Detroit, gave an address advocating closer co-operation between the illuminating engineer and the architect. He agreed that the day has passed when the architect can successfully pose as the autocrat in connection with everything that pertains to building. As a direct result of the advent of specialists, such as structural engineers, sanitary engineers, heating and ventilating engineers, etc., demands for valuable space for flues, ducts, pipes and mechanical equipment have been made. None of these intrusions was made without struggle and combat. The same applies to the work of the electrical engineer.

"The differences, misunderstandings and unwise, and, many times, foolish contentions which marked the advent and progress of the careers of these various types of engineers, have at this late day been repeated in the unavoidable relations between some architects and illuminating engineers. These have for the most part been directly attributable to a local condition or an unexpected alteration which was not discussed during the interview prior to the completion of the electrical specifications. . . . The resultant disagreement relative to the assumption of the responsibility for the error is sometimes temporary and sometimes permanent. In either case the disadvantages and probably injustice done to both architect and engineer are serious." As illustrations of such misunderstandings Mr. Malcolmson referred to the choice of colour or patterns for ceilings, which may lead to lighting plans not fulfilling expectations.

As an indication of the proper basis of co-operation between architect and engineer, Mr. Malcolmson read the following statement "from an authority highly regarded by the Assembly":—

"An architect may form his idea of what constitutes a proper relation between the size of a lighting fixture and its environment on the basis of appearance only, thus either making it much smaller or more prominent than it need be to do its work properly; or he may take an illuminating engineer into consultation who, knowing how much light is required now or may be demanded in the future in this environment, and what the safe limits of brightness are now or may be in future, proceeds to determine the proper size of the lighting devices on a scientific basis, and then leaves the dressing up of the light sources entirely in the hands of the architect with the understanding that no violence shall be done to the skeleton that has been prepared. On the other hand, an engineer may proceed unintelligently, without advice from any architect, to design an illumination which shall be ample as far as the doing of work and avoidance of eyestrain are concerned, but which fails to throw light properly upon and show up the architectural features of the room or building, and thus needlessly sacrifices or distorts an artistic creation.

"Ideally, it seems to me, the architect as an artist, and the engineer as a scientist, should in the beginning sit down amicably together and determine what are to be the main objects of the illumination in a given projected installation—whether, for instance, æsthetic or economic considerations should rank second in importance to visual hygiene and safety. If æsthetic considerations be more important than economic, as for instance in a home or in a church, the engineer should receive some instruction from the architect as to the effects to be produced, whereas if economic considerations be more important than æsthetic, the engineer may be somewhat more independent, although he should always seek advice as to how to make anything as beautiful as possible without undue sacrifice of economy. When the objects have been determined it seems to me that the engineer should be given freedom to decide upon the means to be employed for producing the desired effects. When he has reached his decision upon means, his specifications and plans for lighting should be submitted to the architect in most cases (certainly where æsthetic considerations are important) to ensure that he has not violated any artistic proprieties, and to give the artist an opportunity to dress up the machinery and hide its ugliness if need be. Finally, the artist's plans for the outside dress of the lighting equipment should be resubmitted to the illuminating engineer for the purpose of ensuring that no violence has been done to the eye and no unnecessary violence to the exchequer in making the whole thing agreeable to the eye. This is analogous to submitting page proofs to the author to ensure that the artist in book-making has done no violence to the text after the galley proof has been corrected.

If this type of co-operation should be entered into purposefully and generously by both engineers and architects it would seem that the best possible results should ensue and lighting installations would be more beautiful and appealing than ever before, without sacrifice of eye-health, safety, or economy."

"Economies" in Lighting

HOW slowly the notion dies that, whatever expenditure may be incurred in other directions, domestic lighting exists simply to provide opportunities of economy! The other evening the writer was gleefully informed by a lady that she had arranged for only two instead of three lights to be used in the library; she had that day hired a motor-car for the purpose of an afternoon's shopping in down, and had doubtless spent several pounds in her purchases; yet when it was pointed out that the economy could not be expected to save more than a penny a day the contrast did not seem to strike her.

Nor is this instinct for economy confined to the fair sex. During a recent holiday the writer visited the country home of a man obviously wealthy. The house contained many valuable pictures and delightful old furniture. The grounds were charmingly laid out, and the furnishing of the beds on the small terrace in front of the house must have cost a small fortune. There was only one thing at which he jibbed. He spoke with awe of the cost of introducing electric light, and was resolved to continue with oil lamps.

Whence comes this deep-rooted impression that whilst all other gifts can be enjoyed light is to be used so parsimoniously? Possibly it is a tradition handed down from the days when artificial light was scarce and candles formed a considerable item in a small budget. But it may shrewdly be suspected that this instinct, if it existed, has been fortified by the early ill-advised propaganda of those in the lighting industry. It dates back to the early days of gas and electric lighting, when any new appliance was recommended solely on the ground that it "reduced your bills," when the best, in fact the only, argument put forward for an illuminant was that it was cheaper than others. In other words, purveyors of light are themselves largely responsible for this view of lighting.

Propaganda based entirely on saving is now a thing of the past. Arguments are now rightly based on the suggestion that artificial light, in comparison with other commodities, is so cheap that it can be generously used; and that it is false economy to diminish the comfort of the home for the sake of saving a few shillings. In the commercial field the question of cost *per se* is now much less emphasized. Merchants are already coming to recognize that the benefits of good lighting are out of all proportion to the cost, and that the main consideration is to ensure that the lighting is thoroughly adequate. It is chiefly in domestic lighting that the old habits linger, and chiefly amongst people who are advanced in age and were brought up with the instinct for small economies. The younger generation are now growing up accustomed to freedom in the use of light, and as a rule have a better sense of proportion in this matter.

Modern Light Therapy

A paper recently read by Dr. Percy Hall before the West London Medico-Chirurgical Society, and summarized in the *British Journal of Actino-Therapy*, contains a review of the effects of "artificial sunlight" treatment of various diseases. Pure sunlight such as is obtained in the High Alps contains about half an octave of ultra-violet rays. In artificial illuminants we have a much wider range, and discretion is necessary in selecting the quality of radiation and the "dosage." The longest waves penetrate to the subcutaneous tissues, and are probably converted into heat rays and absorbed. The shortest waves only penetrate as far as the horny layer of the skin, but are intensely bactericidal. The medium wavelengths (those ranging from 3,000 to 2,000 A.U.) are those which probably produce the greatest physiological effects upon the human body. These waves penetrate the skin as far as the blood-vascular layer, where most of them are absorbed. The "erythema" (pigmentation of the skin) really bears no relation to the deeper and complex changes. Pigmentation differs very greatly in different individuals; in an extreme form it may prejudice treatment by interposing an obstructive layer.

In the conclusion of his address Dr. Hall gave a long list of the most varied forms of disease which were being successfully treated by these rays. Besides such well-known diseases as tuberculosis, rickets, etc., many skin diseases and ulcers can be benefited; likewise anæmia, neurasthenia, and rheumatic affections.

Another effect of considerable interest is mental stimulation. Depressed and melancholy states due to debilitated health are frequently dissipated after a few doses of light. Experiments upon children have shown that mental processes are accelerated and improved.

In the course of a discussion on the paper, Dr. Howard Humphris mentioned that at Drury Lane Theatre some of the healthy young adults took advantage of the artificial sunlight treatment and some did not. Of the former not one had been out of the bill for a single performance since the institution of the treatment, whilst various troubles had caused the usual number of absentees amongst those who did not avail themselves regularly of the treatment. He considered that the effects of actino-therapy in regard to rejuvenation in middle age were little short of miraculous. Replying to various queries, Dr. Hall said that heat rays in relative excess adversely affected the action of the ultra-violet rays. Bad or toxic effects of helio-therapy or actino-therapy were merely instances of ill-chosen cases and wrong dosage. Technique was of paramount importance, and included choice of source of light, initial and continued dosage, spaces of doses and total number.

The Properties of Clear Fused Glass

In a recent paper before the American Illuminating Engineering Society Mr. E. R. Berry illustrated the properties of clear fused quartz. He showed how a 15 in. rod of this material transmitted light practically unchecked, whereas it is highly absorbed by a similar rod of ordinary glass of the finest quality. Heat is similarly conducted. The interesting thing is that if the rod is curved the radiation still remains within the cross-section of the quartz and emerges at its extremity —a property that has been applied in the design of special "leading-in tubes" for the illumination of microscope fields, etc. The most noteworthy property of quartz, however, is its permeance to ultra-violet rays, as illustrated in the tubes commonly used with mercury-vapour lamps for light-treatment. Mention of this property led the author to give a short account of the application of "artificial sunlight" for medical treatment. He mentioned incidentally that the value of light as a curative force is not a new idea, but rather a rediscovered one. Sanatoria based on treatment with sunlight were in use in Europe several hundred years B.C.

Air Bubbles in the Eye

In *The British Journal of Ophthalmology* Mr. R. Foster Moore mentions a curious case of a man who was using a hammer and chisel when something flew into his eye. On examination it was found that there were two air bubbles floating about in the eye, apparently introduced at the puncture caused by the steel fragment. The steel fragment was removed by the giant magnet, and the eye made a perfect recovery. To most people it will come as a surprise to hear of air bubbles floating about in the vitreous, and the effect is supposed to be of rare occurrence. It is suggested, however, that careful examination within a few hours of the accident would often reveal their existence. In the author's experience they have always been multiple, often looking like a "string of toy balloons of various sizes in contact with each other." They are soon absorbed, and apparently leave no ill-effects behind.

Polarized Light and Animal Metabolism

With reference to the alleged action of polarized light on the germination of seeds and the growth of vegetation, commented upon in our last issue, we notice an account in *Nature* of some experiments which suggest that polarized light has also a specialized action on certain bodily processes. The experiments were made on rabbits and guinea-pigs enclosed in hutches exposed to light of similar intensity, but in one case polarized and the other normal. As an indication of metabolic activity the amount of carbon dioxide exhaled in a given period was noted. It was found that this was appreciably greater in the case of the animals subjected to polarized light. Here we have yet another example of obscure influences of light which may also apply to human beings. In this field there is doubtless much still to be learned.

Sun-cycles and Increase in Population

A novel theory has been recently advanced by Dr. Charles A. Bentley, Director of Public Health to the Government of Bengal, who has been attending a series of conferences on child welfare in England. In America and India it is believed that there is a well-defined "crop-cycle" in plant life. These cycles are associated with changes in solar radiation. Dr. Bentley advances the theory that fluctuations in the birth-rate are subject to the same effect. In support of this view he refers to the decline, during the last 25 years, of 30 per cent. in the birth-rate in Bengal—where influences such as birth-control, to which the decline of the birth-rate in European countries is widely attributed, cannot be supposed to operate. If this theory is confirmed yet another instance of the profound effect on solar radiation on our daily life has been discovered.

Central Station Revenue from Residence Lighting

The electrical industry is at present concentrating attention to a great extent on the heating and cooking domestic load, as a means of improving the power factor. But it should be realized that, from the *revenue standpoint*, lighting still forms one of the most important sections of the business. According to an article in the *Electrical World* the 1925 revenue from lighting was 67 per cent. of the total. Yet it is estimated that only 25 per cent. of the total electrical energy generated in that year was consumed for lighting.

Of the lighting revenue in 1925 41 per cent. was contributed by domestic lighting. This represents about 28 per cent. of the total revenue received. At the same time the total consumption in the residential field was only 9 per cent. of the total production of energy. By raising the standard of residence lighting to one of convenience and adequacy it is estimated that this 28 per cent. could readily be raised to 40 per cent., or even 50 per cent. or more.

Moreover, once the movement is started the progress towards greater residential use of electricity will be largely automatic. It is only within recent years that supply undertakings have realized the great possibilities in the domestic load.

The New Factory Bill

IMPORTANT PROVISIONS ON LIGHTING.

The Factories (No. 2) Bill, which has just been issued, contains important provisions in regard to lighting, which are as follows :—

(1) Effective measures shall be taken for securing and maintaining sufficient and suitable lighting in every part of the factory in which persons are working or passing.

(2) The Secretary of State may, by special order, prescribe a standard of sufficient and suitable lighting for factories or for any class or description of factories or parts thereof, or for any process.

(3) All glazed windows and skylights of workrooms shall, so far as reasonably practicable, be kept clean on both the inner and outer surfaces and free from obstruction.

The Bill falls into two parts, I (General Provisions for Health) and II (General Provisions for Safety). The former relate to such matters as cleanliness, temperature, ventilation and lighting ; the latter chiefly to precautions necessary to avoid accidents from moving machinery, vessels containing dangerous liquids, hoists, cranes and lifts, etc., and to ensure safe means of access thereto.

Some time will doubtless elapse before the Bill becomes an Act, but the inclusion of provisions for adequate and suitable lighting is a most satisfactory step.

Journalists and Peace

ANNUAL DINNER OF THE BRITISH INTERNATIONAL ASSOCIATION OF JOURNALISTS.

At the Annual Dinner of the British International Association of Journalists, held at the Criterion Restaurant on July 23rd, Viscount Cecil, of Chelwood, who proposed the toast of the Association, referred sympathetically to the object of the Association of developing friendly intercourse between journalists in different countries, and thus contributing to the maintenance of peace. He wished success to the gathering of journalists of different nations in London, which he understood was in contemplation for next year. International journalists constituted a new and interesting development. Their function was to be the diplomatic agents of peoples and contribute to an international friendly understanding. In order to bring the nations into closer contact it was also desirable to have full publicity for the work of the League of Nations, which had shown its desire to do all it could to facilitate the co-operation of the Press in its deliberations.

The Rt. Hon. T. P. O'Connor, M.P., President of the Association, who occupied the chair, in responding to the toast, remarked that journalists had an esprit de corps perhaps greater than that of any profession, and their influence on international relations could hardly be exaggerated. Unless the Press of the world was as firmly united as the leading statesmen in the cause of peace, peace could not be maintained.

The toast of " Our Guests " was proposed by Sir Harry Brittain, M.P. (Past President), who referred to the many visits of the members of the Association to foreign countries, and the assurances they had received from diplomatic representatives of the value of the services they carried out. The toast was responded to by M. Benjamin Vogt (the Norwegian Minister), Mr. Victor Braf (the Czechoslovak Legation), and Mr. Raymond Swing (Secretary of the Association of American Correspondents in London).

Amongst others who were present at this successful gathering may be mentioned the Italian Ambassador (the Marchese della Torretta), Mr. N. Ciotoru (Roumanian Legation), Mr. K. Ruuskanen (the Finnish Legation), Senor Don Manuel de Ynclan (the Spanish Embassy), Mr. J. C. Van der Veer (President of the Foreign Press Association), and a representative gathering of members of the B.I.A.J., including Mr. L. Gaster, the Hon. Gen. Secretary.

The Work of the British Science Guild

In the August issue of the *Journal* of the British Science Guild there is, as usual, an account of the proceedings at the annual meeting, held in April last. Sir Richard Redmayne's address on "The Future of the Coal Mining Industry" contains suggestions which go to the root of the prosperity of the industry, and, in the light of subsequent events, more than ever deserve thoughtful study. Dr. E. F. Armstrong's address on dyestuffs, and Mr. Twyman's account of progress in the British Optical industry are also reproduced. The pre-eminently scientific nature of the optical industry renders progress in this field specially gratifying. Mr. Twyman asserts that the industry has now come to a stage " where the more severe the tests of their instruments, the better they are pleased," and he pays a tribute to the very valuable research done by the National Physical Laboratory in this field.

Reference is also made to various interests of the Guild, notably the catalogue of British Scientific and Technical Books which is now in its second edition, and the Science Publicity Service Scheme, which is still in course of evolution. There is also a note on the taxation of scientific societies. Existing legislation gives relief in several respects to scientific institutions. The chief difficulty lies in the definition of this term.

A new feature is the series of paragraphs entitled " Musing in Unscientific Method," which are frankly humorous in tone, but contain some palpable hits.

Entertainments that Appeal to only One Sense

One rather interesting point raised in the " Musings referred to above is the effect of what is termed " one-sense drama "—such as the cinematograph, which appeals only to the eye, and broadcasting, which appeals only to the ear—on the emotional side of the mind. Dr. H. P. Newsholme has suggested possible pernicious effects. " In the case of the cinema, the conditions—darkness, quiet, an intent company, the stimulation of one sense by a well-defined area of bright light—tend to an hypnotic state in the observer." It is suggested that impressions may pass beyond the conscious to reach the subconscious stratum of the mind, where the message conveyed by the film remains unknown to the individual but nevertheless potent in its effect on the growth of the character.

Music is also a one-sense appeal, and is an art of great antiquity ; but we cannot recall any apprehensions having been expressed about its influence on the subconscious mind !

International Congress for Life-Saving and First Aid to the Injured

The Third International Congress for Life-Saving and First Aid to the Injured will be held in Amsterdam during Sept. 7th–11th, 1926.

The Organization and Administration of a Public Street Lighting and Maintenance Department

A contribution by Mr. R. E. Rogers, of the City Lighting Department, Liverpool, in *Municipal Engineering*, contains some useful hints on the organization of maintenance of street lighting. A considerable amount is said and written about the principles of street lighting; but the duties of those entrusted with the task of keeping the large number of lamps in a big city in working order are apt to pass unrecognized by the public.

On the whole, it must be said that this class of work is done conscientiously in most cities. Nevertheless, good service is only ensured by constant vigilance on the part of inspectors, and the amount of work that is done in checking records of work and supervising operators is much greater than is commonly imagined. Mr. Rogers refers to the human tendency to keep in a rut. In street lighting provision has often to be made for the unexpected. Apart from the usual routine "emergency reports" of defects are constantly coming in, and must be attended to. Mr. Rogers mentions as a wise understanding that under no circumstances must a refuge or anything constituting an obstruction in the roadway be left unlighted. If necessary, on any emergency job, a man must take out with him a hurricane lamp and fix it to the obstruction. Trimmers, though given a full day's work before starting out, are expected to at once report and put right any lamp seen to be out of order. A feature in keeping men up to the mark is the system of surprise inspections; in some cases it is desirable that the same man's work should be inspected several times during the same day, as this gives a salutary impression of the vigilance of inspectors.

Public Works, Roads and Transport Congress

PRIZES IN CONNECTION WITH 1927 CONGRESS.

We are informed that the Congress Organizing Committee have decided to offer a series of prizes for papers which are submitted for discussion at the Public Works, Roads and Transport Congress and Exhibition, to be held in November, 1927. The prizes are as follows: First prize, gold medal and £50; second prize, silver medal and £25; third prize, bronze medal and £10. The competition is open without restriction of nationality, but the subject of each paper must be one of those falling within the services covered by the Congress. Papers must be submitted not later than January 17th, 1927. Full particulars of the rules for the competition are obtainable from the Hon. Secretary, Public Works, Roads and Transport Congress, 84, Eccleston Square, London, S.W.1.

Competition for Industrial Designs

A selection of designs received in the Competition of Industrial Designs (1926) organized by the Royal Society of Arts, is being exhibited at the Imperial Institute, South Kensington, during July 31st—August 31st. The exhibition is free of charge, no tickets being required, and includes designs in architectural metal work (shop fronts, window frames, etc.), wallpapers, textiles, furniture, printing and book production, china, earthenware and glass, as well as posters, showcards, etc. A Bureau of Information is being established by the Royal Society of Arts in connection with the competition, at which will be kept the names and addresses of exhibitors who desire to obtain employment as designers.

TRADE NOTES & ANNOUNCEMENTS

INTERNALLY FROSTED LAMPS.

In our last issue we referred to the introduction of lamps frosted on the inside, which are claimed to have some material advantages. The exterior of the bulb is quite smooth, so that they are easily cleaned, and the absorption is stated to be very low. It is generally thought that these lamps will take the place both of the clear and "outside-frosted" lamps, thus reducing the number of lamps to be carried by the retailer. Illuminating engineers would certainly welcome any novelty which seems destined to replace the bare lamp by one giving good diffusion.

The idea of inside frosting is not new. It was tried many years ago, but was found to render the bulb too fragile. This fragility was due to the jagged edges of the etched glass, and in the new treatment these rough edges are rounded off.

We have already recorded the introduction of such lamps by the British Thomson-Houston Co. Ltd. The "Osram Pearl Lamp" is now likewise announced by the General Electric Co. Ltd. It is only a short time since the white-sprayed lamp was developed in the G.E.C. Research Laboratories, and it will be interesting to see how far this is replaced by the "Osram Pearl Lamp," which, with its internal frosting, seems to have the advantage. Sprayed lamps have, however, had a special vogue in the "colour-sprayed" variety. It remains to be seen whether colours can also be conveniently applied internally.

We understand that internally frosted lamps will also be handled by Philips Lamps Ltd. and other firms, so that they should quickly be available in large quantities.

Lamps of this description ("Siemens-Purlite") are also being now supplied by Messrs. Siemens and English Electric Lamp Co. Ltd. We understand that the gasfilled lamps are of standard construction, but the vacuum lamps have spiralized filaments, and also utilize the characteristic shape of bulb which is one of the features of these internally frosted lamps.

A NEW PHOTO-ELECTRIC CELL FOR MEASURING "DOSAGE."

One of the chief problems still to be solved in artificial sunlight treatment is the determination of "dosage" by some convenient instrument. A new form of photo-electric cell devised by Messrs. Griffith & Taylor, of Aberdeen, and now being introduced by Messrs. Watson & Sons, has promising qualities for this purpose. The cell utilizes the well-known photo-electric effect, according to which the rate of emission of electrons from certain materials is proportional to the intensity of the source to which they are exposed. In order to measure ultra-violet light for therapeutic treatment it is essential to choose a material sensitive mainly to the wavelengths responsible for therapeutic action. Cadmium exposed behind a quartz window fulfils this condition well. It is stated that cells so constructed are insensitive to visible light of a wavelength greater than $350\mu\mu$, whilst the quartz window cuts off all radiation down to $200\mu\mu$. The maximum sensitivity within these limits is situated approximately at $300\mu\mu$, which is the region of greatest biological interest.

CONTRACTS CLOSED.

The following contracts are announced :—

MESSRS. SIEMENS AND ENGLISH ELECTRIC LAMP CO. LTD. :
H.M. Office of Works; for the supply of a large quantity of Siemens Vacuum and Gasfilled Lamps over a period of one year as and from July 23rd.

THE GENERAL ELECTRIC CO. LTD. :
London General Post Office; for 150,000 Robertson Telephone Switchboard Lamps.

METRO-VICK SUPPLIES LTD. :
H.M. Office of Works; part contract for "Cosmos" Vacuum Lamps for 12 months from July 23rd, 1926.

DEVELOPMENTS IN NEON SIGNS.

During a recent visit to the premises of Messrs. Philips Lamps Ltd. we were interested to learn some particulars of the neon signs, which this firm is now introducing. During the coal strike advertising lighting effects naturally cannot be developed much, but as soon as this obstacle is removed it is probable that these neon signs will arouse considerable interest. One of the chief features is that the signs can now be designed to give either red, blue, or green light. As is well known, the departure from the ordinary red-orange hues of the neon light is effected partly by introducing minute impurities. In some cases (as in the case of the green light) coloured glass is also used to get the desired effect. We understand that the blue light is unusually vivid.

Tubing containing neon gas can be worked up into any desired form, and the low consumption of such signs is a distinct advantage. They are best adapted to alternating current, a fairly long length of tube requiring up to 3,000 volts, which is obtained from a small transformer. Smaller signs, for use in shop windows, can be worked on 1,000 volts. Neon signs can also be operated off direct current with the aid of an interrupter, but the effect is admittedly not quite so satisfactory.

We were particularly interested in a special method of eliminating the flicker to which neon signs are occasionally subject. The process is based on the addition of a conducting layer spread over a portion of the tube and attached to one terminal.

Neon tubing is particularly applicable to script lettering, but individual interchangeable letters can now be used. We were shown an illustration of a very compact and neat box sign, in which individual letters, all run in parallel, can be changed about so that any desired wording can be presented in luminous form.

SHOP LIGHTING WITH GAS.

A recent issue of "A Thousand and One Uses for Gas" is devoted to shop lighting. In an introductory note on "Preparing for the Dark Season" attention is drawn to the value of window lighting in attracting business, and it is pointed out that improvements in lighting are best initiated during the summer months, before the "rush" period has begun. There are a number of attractive pictures of installations using fittings of the semi-indirect type. A convenient feature of such installations is that all the types of lamps recommended are fitted with mantles of the same size. This facilitates maintenance work considerably. Modern methods of distant control are also of considerable aid to the shopkeeper, as they enable outside lamps to be lighted up or extinguished by control from inside the shop. There is a growing tendency for leading shopkeepers to keep their windows lighted after business hours, so that they serve as an effective and economical advertisement. Parade lighting is also becoming a regular feature in business areas, where enterprising merchants combine to meet the cost of a row of lamps outside their premises.

PERSONAL.

Mr. E. R. Wynne, A.M.I.E.E., has joined the Board of Messrs. Lewenz & Wilkinson Ltd., 25, Victoria Street, London, S.W.1, as co-managing director with Mr. H. L. Lewenz, and will look after the firm's home agencies and industrial electrification contracts.

THE CHROMOSCOPE CO. LTD.

CHANGE OF ADDRESS.

Readers are requested to note that the address of the Chromoscope Co. Ltd. is now Victory House, 15, Leicester Square, London, W.C.2. (Telephone: Gerrard 1158. Telegrams : "Kromoskop.")

THE INTERNATIONAL ELECTRIC LAMP SYNDICATE.

It is common knowledge that since the war there has been a growing movement towards international action on the part of the leading electric lamp makers of the world. In *Licht und Lampe** a brief account is given of the proceedings at the general conference held in Geneva last June, and arranged by the Phœbus A.G., which acts for the entire European lamp industry, and is also in close relation with the industry in North America. At this meeting about 80 representatives from different countries were present. It was reported that the organization is becoming even more complete, as during recent years a number of firms formerly outside it have joined. The whole business, though involving many variable factors, has now attained great stability. One of the main subjects considered was the extension of business by the promotion of propaganda encouraging better illumination. Examples of successful results following efforts in this direction in the United States were quoted. Common action by all firms in co-operation with electrical supply undertakings and electrical contractors in various countries was resolved upon.

From the technical side good progress has been made towards standardization of lamps, in particular with regard to lamp sockets, for which standards for adoption all over the world are being recommended. There is no doubt that in the near future such standards will be universally adopted.

Further efforts are also being made to standardize the shapes and sizes of lamps, though procedure in different countries in this respect differs considerably, so that variations in practice can only gradually be removed. It is very much to be desired that this problem, which is of special importance to manufacturers of fittings, glassware, etc., will be solved in the near future. Agreement has also been reached regarding the introduction of internally frosted lamps. It is expected that, as already announced by the Osram-Gesellschaft in Germany, such lamps will be in general use by the beginning of next year.† In the United States the greater part of production has already been converted to this type of lamp. How far the anticipated diminution in the cost of manufacture will prove practicable, and to what degree this novelty will make possible a further diminution in the troublesome variety of shapes of lamps remains to be seen. It is unnecessary to recall that such variations in shape have in the past frequently proved detrimental to the proper combination of lamps and fittings.

SWITCHGEAR ABSTRACTS.

No. 5 of the above abstracts, issued by Messrs. Johnson & Phillips Ltd., deals with M.T. air-break circuit breakers, M.T. fuses, knife switches and isolating switches, etc. The mechanisms are explained by numerous diagrams, and a curve showing the operation of a standard reverse current release is presented. The M.T. fuses (up to 660 volts) of the porcelain-handle type have specially interesting features.

AN ULTRA-VIOLET RAY SPECTROMETER.

Whilst the nature of the ultra-violet spectrum rendered by various forms of lamps can be studied with some minuteness in the laboratory, there has hitherto been a lack of convenient apparatus by which such radiation can be readily examined with the lamps *in situ*. A little apparatus, the ultra-violet spectrometer, introduced by Messrs. Bellingham & Stanley, seems likely to be useful in this connection. This is quite compact in form. By means of an arrangement of prisms and mirrors the ultra-violet spectrum is isolated and received on a fluorescent screen of special design, and a wavelength scale enables particular lines to be recognized. We have previously commented on the need for fuller information on the spectra of lamps, and also on the use of spectrometers for demonstration purposes at a recent exhibition of artificial sunlight lamps by Messrs. Arnold & Sons. The catalogue of this firm contains a description of a pigmentation meter and other devices designed to regulate dosage. In view of the great diversity of lamps now on the market, the need for both qualitative and quantitative study of their radiation is evident.

* July 20th, 1926.

† As indicated on p. 246, such lamps are already being introduced into this country.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

PHOTOMETRY; *by John W. T. Walsh, M.A. (Oxon), M.Sc. (Lond.), A.M.I.E.E., F.Inst.P. (Constable & Co. Ltd., London,* 1926; *pp.* 505, *figs.* 303. 40*s. net.)*

In the preface to this work it is remarked that whilst there are several good books on photometry in existence (notably Dr. Liebenthal's comprehensive "*Praktische Photometrie*"), none of those that have appeared recently have dealt exclusively with the subject. Moreover, many instruments and much apparatus have been developed during the past 15 years. The time therefore seemed ripe for an up-to-date treatment of the subject.

The book before us is doubtless a very comprehensive one, and Messrs. Constable & Co. are to be congratulated on according so much space and including such a generous allocation of illustrations, which were prepared by Mr. F. G. H. Lewis. The chief feature of the book, however, is the very complete series of references arranged at the end of each chapter; there can be few papers on photometry during recent years which have been overlooked. In an appendix there is also a list of books treating photometry to a greater or less extent.

Chapter I is devoted to a brief historical survey. Next we have a discussion of radiation, in which the theory of light and some fundamental phenomena are treated. Following this there is a chapter devoted to "The Eye and Vision." The mechanism of the eye is illustrated, and the author deals with a number of fundamental effects, such as the nature of glare, the relation between illumination and visual acuity, effects of adaptation, persistence of vision, etc. The latter leads to a discussion of the flicker photometer and a general account of the Purkinje effect. A useful feature is the reproduction of numerous curves and diagrams which are familiar to experts but are not usually dealt with so fully in books on photometry. The author prefers to express the periodicity of radiation in terms of frequency or "wave-number" rather than wavelength, and this is adhered to throughout the book. In most of the diagrams both wavelength and wave-number are set out—a judicious step in view of the fact that to most people the wavelength is still much the more familiar method.

We then pass on to a general discussion of the principles of photometry, and the author takes the opportunity to define the chief photometric quantities. Polar curves of light distribution and the derivation of mean spherical candle-power are explained, and there are some formulæ for the calculation of illumination derived from objects of specific shape which are not "point-sources." This again is information not usually found in books on photometry; besides illustrating the application of the inverse square law, these relations are not without value in relation to practical lighting installations, where some effort to determine the illumination derived from an extensive luminous surface has occasionally to be made. We notice that the chapter contains some illustrations of the "iso-candle" diagrams introduced by Benford in the United States.

In the next chapters, dealing with standards of light and the measurement of candle-power, light-distribution and flux, the author makes good use of his experience at the National Physical Laboratory, and furnishes a thoroughly up-to-date and efficient treatment of the subject. The account of the use of the photometric bench and all its details is particularly useful (though we do not think the author would endorse the filament of the small lamp used to illuminate the scale being visible, as is shown in Fig. 76). We notice on page 185 a reproduction of Uppenborn's curve relating observation error to illumination of photometer-surface. Is it a confirmed fact that the error is a sharp minimum with an illumination of about 2 foot-candles? This seems inconsistent with the advocacy of much higher industrial illuminations, on the ground that the powers of perception of the eye are thus increased. It seems to be agreed that the Lummer-Brodhun contrast field is the most sensitive yet devised, though a properly prepared grease spot is nearly as good. The treatment of the integrating sphere is adequate, and some data on the use of cubical and other structures are also given, though we would have liked to see a little more guidance on their practical possibilities.

The chapter on heterochromatic photometry describes the cascade method, the use of coloured filters and solutions (such as that due to Crova), and the various flicker photometers, on which information supplementary to that already given in Chapter III is presented. We think most observers will agree with the conclusion that in testing lamps whose light shows only a moderate difference in colour photometers based on equality of brightness are best; when the colours differ very radically flicker photometers may be easier to use, but some doubt as to the interpretation of results must always exist. The two ensuing chapters dealing with spectro-photometry and the measurement of colour include a great deal of information that is not commonly found in textbooks. The Nutting-Hilger instrument, with which much useful work has been done in this country, rightly receives a fair share of attention. Work done on the mechanical equivalent of light and the standard visibility curve is summarized and the chief forms of colorimeters are described.

The discussion of physical photometry (Chapter XI.) is of special interest at the present time. A very complete series of references to work in this field, much of which is little known in this country, is given. The difficulties involved in the use both of selenium and photo-electric cells are indicated, and the impression is given that for the time being such cells are likely to prove most useful for comparative work, such as the plotting of polar curves or the study of variations in a given source under different conditions. The departure from the luminosity curve of the eye throughout the spectrum renders comparison of sources yielding widely different radiation difficult, though the "thalofide" material used in the Case cell appears more hopeful in this respect. The road towards the design of a direct-reading portable illumination-photometer based on physical photometry is beset by numerous difficulties, notably the very small currents that have to be measured; it was understood, however, that Mr. Case had made considerable progress in this direction with his "thalofide" cell, which is here briefly mentioned. Recent investigations in this country seem to have been mainly conducted with the photo-electric type of cell.

Another chapter that will be read with great interest at the present time is that dealing with illumination photometers. This is brought up to date by reference to the British Standard Specification for Portable Photometers, and one of the chief problems mentioned therein, the difficulty in obtaining a truly diffusing test-surface, is discussed. The compensated reflecting test-surface, little known in this country, seems to deserve more study. There is a well-illustrated account of recent forms of instruments. We believe the author is the first to include in a textbook an adequate account of the modern form of the Holophane Lumeter. The Trotter, Macbeth, Sharp and Millar, and other well-known forms are also described, and there is a brief discussion of daylight photometry. Final chapters deal with the measurement of brightness, the photometry of projection apparatus, stellar photometry, and the equipment of the photometric laboratory.

This is doubtless the most comprehensive work on photometry yet published in this country. The type and illustrations are good, and there is an adequate index. The chief feature of the book, as already remarked, is the very complete series of references, in which mention is made of many contributions presented before the Illuminating Engineering Society or appearing in *The Illuminating Engineer*. We are glad to see that acknowledgment is thus made of the researches of the large number of workers who have contributed to the advance of photometry during recent years.

THE LEAD STORAGE BATTERY; *by H. G. Brown, A.M.I.E.E. (The Locomotive Publishing Co., London,* 1926. *Second Edition, pp.* 186; *figs.* 96; *price* 5*s.)*

The second edition of this work contains a good general review of lead storage batteries. After a brief analysis of the chemistry of the cell, its main characteristics and capacity and

voltage curves are illustrated. (To users of illumination-photometers it is of interest to note that even on open circuit there is a gradual drop in voltage, most pronounced in the hours immediately follow the charge). Subsequent chapters deal with the formation and structure of plates, the erection of cells, and auxiliary apparatus, such as boosters, regular switches, etc. There is also some practical advice on storage-battery working and repair, and on the testing of batteries. In the final chapters some types of cells designed for special classes of work are described.

THE BEAMA BOOK. *(Issued by the British Electrical and Allied Manufacturers' Association, London, 1926.)*

This booklet, containing a short survey of the work of the B.E.A.M.A. and of recent progress in the electrical industry, was first issued in February, and has now been reprinted. The importance of co-operation, standardization, research and education in the electrical industry are emphasized, and attention is drawn to the general acceptance of the principle of "service" to the community. Some statistics, notably those relating to some of the largest electrical central stations, show the steady advance in efficiency. Many illustrations show the varied applications of electricity in industry. In the section on "Illumination" reference is made to the important part played by good lighting in the cotton and woollen industries, the uses of electric light for medical treatment, and its applications in stores and for purposes of advertisement.

THE INSTITUTION OF GAS ENGINEERS, TRANSACTIONS FOR 1924–25.

The Transactions of the Institution of Gas Engineers for the past year again make a bulky volume, occupying over 700 pages. The Presidential Address delivered by Mr. Ferguson Bell contained some striking figures showing the growth of the gas industry. It is clearly absurd for anyone to think of this as "a dying industry," when the progress both in number of consumers and make of gas has risen almost uninterruptedly since 1913. The number of consumers rose from about 236,000 in 1913 to nearly 300,000 in 1924, and the make of gas during the same period from 220,000 to over 270,000 millions of cubic feet. It is interesting to observe that notwithstanding the great progress of electricity, the gas industry in the United States has also been making rapid progress. During 20 years, from 1903 to 1923, the sales of natural and manufactured gas rose from 224,000 million to 1,130,000 million. The latter quantity is thus four times the whole of the make of the authorised undertakings in this country (about 800 in number), but it must be remembered that approximately three-quarters of this amount consists of natural gas. In certain districts the supply of natural gas appears to be giving out; but its use in large quantities has so accustomed users to the convenience of gaseous fuel that they are not likely to return to solid fuel. The Transactions also contain the report of the delegates to the International Illumination Commission, and the report of the committee on the aeration of gas burners, besides a number of other papers and reports of technical interest.

TRANSACTIONS OF THE ILLUMINATING ENGINEERING SOCIETY (U.S.A.).

The last issue of the Transactions of the American Illuminating Engineering Society (July) contains much varied matter. A paper by Prof. H. H. Higbie describes an interesting system, mainly indirect, of lighting a large reading room; general "cove-lighting" being assisted by the use of a special form of local reading lamp. There is also a paper by C. E. Ferree and G. Rand on the effect of mixtures of artificial and natural light, and a contribution by Mr. F. E. Carlson on the relative values of daylight and light from the tungsten lamp and the mercury-vapour lamp when applied to work on metals. A feature of recent issues of these *Transactions* has been the increasing space given to short notes from various sources, in which some relating to the doings of the Illuminating Engineering Society in this country are reproduced. Attention may also be drawn to an interesting paper by Mr. William Beebe, on various forms of luminescent fish met with during the voyage of the research vessel, the *Arcturus*, some reference to which appears elsewhere in this issue (see p. 239).

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SPECIAL INFORMATION.

THE ILLUMINATING ENGINEER (the Journal of GOOD LIGHTING) was founded in January, 1908, and has thus been in existence for eighteen years.

SINCE the year 1909, when the Illuminating Engineering Society was founded in London, it has been the official organ of the Society.

IT is *the only journal in this country exclusively devoted to Lighting by all Illuminants.*

IT receives the assistance of contributors who are leading experts on illumination in this country and abroad. Foreign Notes and News will be a speciality, and correspondents have been appointed in all the chief cities of the world.

THE Journal contains *first-hand and authoritative information on all aspects of lighting;* it has also been improved and extended by the inclusion of a *Popular and Trade Section* containing special articles of interest to contractors, gas and electric supply companies, Government Departments and members of the Public.

DISCUSSIONS before the Illuminating Engineering Society which are reproduced in this Journal are participated in alike by experts on illumination and *users of light*, whose co-operation is specially invited.

Good Lighting is of interest to everyone. The Journal is read by engineers, architects, medical men, factory inspectors, managers of factories, educational authorities, public lighting authorities, and large users of light of all kinds.

BESIDES being issued to all members of the Illuminating Engineering Society, the Journal has an independent circulation amongst people interested in lighting in all parts of the world. The new and extended form of the Journal should result in a continual and rapid increase in circulation.

Every reader of THE ILLUMINATING ENGINEER, the Journal of GOOD LIGHTING, *is interested in illumination, and is a possible purchaser of lamps and lighting appliances. Gas and Electricity Supply Undertakings likewise benefit by the movement for Better Lighting, with which the Journal is associated, and which stimulates the demand for all illuminants.*

JOIN

The Illuminating Engineering Society.

Monthly meetings are held, at which interesting papers are read, and discussions on such subjects as the lighting of streets, factories, schools, libraries, shops, etc., and exhibits of new lamps and lighting appliances take place.

Members receive *The Illuminating Engineer*, the official organ of the Society, free.

The Society preserves an impartial platform for the discussion of all illuminants, and invites the co-operation both of experts on illumination and users of light; it includes amongst its members manufacturers, representatives of gas and electric supply companies, architects, medical men, factory inspectors, municipal officers, and many others interested in the use of light in the service of mankind.

The Centre for Information on Illumination.

For particulars apply to:

L. GASTER, *Hon. Secretary*,

32, Victoria Street, LONDON, S.W. 1.

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